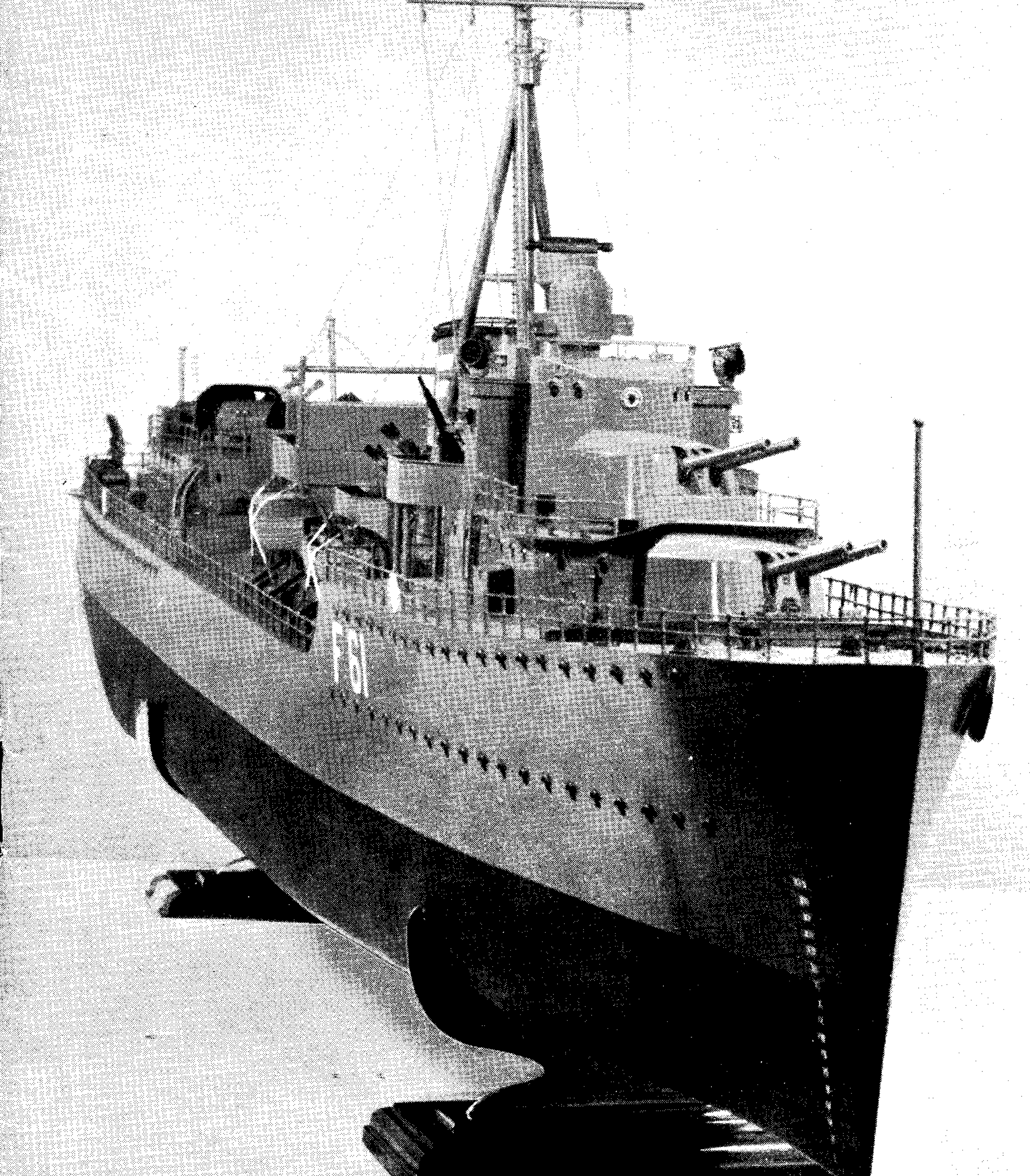
THE MODEL ENGINEER

Vol. 103 No. 2579 THURSDAY OCT 26 1950 9d.



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

26TH OCTOBER 1950 VOL. 103 NO. 2579

SMOKE RINGS

Our Cover Picture

● THIS WEEK we have used a photograph of the *Javelin* class destroyer model which won a bronze medal in the recent "M.E." Exhibition. It was built by G. W. Miller, of West Drayton, and is to the scale of 1/5 in. to 1 ft., giving a length of 70 in. overall. At this scale it is possible to show most of the significant detail and this has been done in the model. The original design, which was published in THE MODEL ENGINEER during 1944, was based on the *Javelin*, but the *Javelin* has been altered so much during and since the war that the model must be considered now as being a representation of a destroyer of the *Javelin* class. Incidentally, in this model, the details shown in the original articles have been checked and amplified in collaboratoin with a nautical modelling friend, which has resulted in a great improvement in the appearance of the model. In the design, the beam is 8 in., which is 1 in. oversize, and the draught 3 in., which is also 1 in. oversize. This, however, as will be seen from the photograph, does not detract from the appearance of the model, but it helps greatly in its stability and seaworthiness. In a long narrow hull such as that of a destroyer it is almost essential to increase the beam in the model to prevent rolling, and in a model of this size, even with the increased beam, the hull still retains the slim appearance which is characteristic of the type.

Appreciation

● WE WERE naturally pleased to receive from a London reader a most appreciative letter, just lately. After asking for some advice and instruction on the subject of scaling up from one scale to a larger one, our friend continued :—

"Although I have read your journal for the past 25 years, I have never before written to you. My model making activities started at the age of seven, and now, 'forty years on' (literally) I am the possessor of a useful workshop and tools which have been acquired over the aforesaid period and I am, perhaps, quite an experienced and capable worker. I am certainly a 'lone hand' and have gained practically all my knowledge from your very excellent journal, and I feel it is about time that I expressed my gratitude for the pleasure and instruction you have given me.

In particular, I would like to express my appreciation of the articles written by 'L.B.S.C.' whom I regard as a friend although I have never met him.

I am at present completing a 6 ft. 6 in. cabin cruiser, with twin-cylinder S.A. engine, $1\frac{1}{8}$ in. by $1\frac{1}{8}$ in., with coal-fired locomotive-type boiler, a feature of which is the radio control system. This is a simple and inexpensive circuit providing 5-channel operation with instantaneous reaction of the controls. I should have everything com-

plete by the autumn, and if it would be of any interest to your readers, I could no doubt let you have details at a later date."

All this seems to us to provide yet another "feather in the cap" for THE MODEL ENGINEER; but our friend deserves cordial congratulations upon his prowess. That radio-controlled cabin cruiser is certainly likely to be of great interest to many of our readers, and we need scarcely add that we are taking steps to obtain details and photographs of it. A locomotive-type boiler in a cabin cruiser is not usual, but we doubt if any other type of steam generator is really more efficient, after all.

We like to think that we have done something towards helping another "lone hand" (even in London!) to realise an almost lifelong ambition; he is already planning another which, he tells us, is to be "L.B.S.C.'s" *Doris*, but for 5-in. gauge; we wish him all luck with it.

An Edmonton Exhibition

● ON SATURDAY, October 28th, from 2 p.m.-9 p.m., the Edmonton Model Car Club will hold a model engineer exhibition at the canteen of Rego Clothiers, Angel Road, Edmonton, in aid of their M.C.C. track fund.

There will be a multi-gauge railway track, general models, the club's portable r.t.p. track, the North London society's "Nordromo" rail track and demonstrations of control-line flying. There will also be a film show on Grand Prix racing. The opening ceremony will be performed by the Mayor of Edmonton.

Here is a chance for model engineers in the Edmonton area (and outside of it, for that matter), to meet the model car enthusiasts and inspect their handiwork!

More Newspaperese

● WE ARE often amused by the attempts of newspaper reporters to make use of technical terms when describing any mechanical device; at the same time, we are often led to wonder whether these people have any idea of the meanings of words. The Brighton and Hove Society of Model Engineers had on view at their recent exhibition an interesting model of a space-ship of rocket form, and in a subsequent news-agency description of it we read: "The model is about 5 ft. high and a full-size rocket *to the same scale* would be about 150 ft. high." The italics are ours, and we are tempted to enquire what would be the height of a full-size rocket to any other scale. Perhaps some of our mathematically-minded readers would care to spend a little time in endeavouring to work out the answer!

Duck-pond Water

● MR. S. R. BOSTEL's letter in our October 5th issue has brought in many replies to explain why traction-engine drivers shunned taking water from duck-ponds. All of them agree that the duck is notoriously dirty in its habits; in addition, ducks frequently groom themselves with oil which is secreted in glands near the tail. If they did not do this, they would become waterlogged and sink! The oil, as it were, waterproofs the feathers. As the duck swims about in the pond, the oil is gradually washed off into the water which thereby becomes unsuitable for most of the uses for which clean water is normally used. Users of steam boilers know only too well that oily water is a very potent cause of priming, and we feel that we need say no more except to thank all those many readers who supplied the answer to Mr. Bostel's question. It may possibly serve as a warning to any operators of miniature locomotive tracks in country districts not to be tempted to feed small locomotives with water from the duck-pond.

Spreading its Wings

● WE HEAR that the Southern Federation of Model Engineers has decided to extend its sphere of influence to include the whole of the counties of Hants, Berks, Wilts, Dorset and Sussex. We think that this decision will be welcomed by model engineering societies in the counties named, and the various hon. secretaries are invited to get into touch with the Federation's hon. secretary, Mr. G. S. Williams, 23, Tintern Road, Gosport, Hants.

A group of people like the S.F.M.E. can do a great deal of good in the cause of model engineering; in fact, since they were founded soon after the end of the war, both the Southern and Northern Federations have continuously served our hobby well. We are not surprised, therefore, to hear that either of them is growing. Moreover, we are inclined to believe that, paradoxically, the reason for expansion is due more to pressure from without rather than within; in other words, more societies are now wishing to join the federations.

There is Always Something Else

● A YOUNG Swedish reader, Mr. Bengt-Erik Modin, of Oscar-Fredriksborg, has sent us an interesting letter telling us of some of his model-making experiences; he writes: "When I was younger, I was like most other boys, interested in airplanes, cars, boats and other things that moved. Some years ago, I began to build sailplanes with a span of about 1 metre. First, I made the drawings myself, but then I bought a kit. One afternoon, I was out on a field alone and drew the model up above me. Then the cord left the hook; the model curved and curved; I saw it sixteen minutes, since then I have never seen it."

After that, our young friend decided that he would never build any more sailplanes, and he has turned his attention to boats. He has sent us a photograph of his first boat together with a few notes and sketches of its construction, and we hope to publish them. Meanwhile, we wish him better luck with his boat than he had with his sailplane.

Calling Mr. J. Warner

● CORBETT'S (LATHES), Stanton Hill, near Stockport, would be glad if Mr. J. Warner would send them his address which he omitted from his letter of October 5th.

Making Aquarium Accessories

by A. R. Turpin

KEEPING tropical aquariums is becoming more and more popular, and I do not think this is so much that people are becoming interested in fishes and their habits, but that they are fascinated by the beauty of a properly stocked and planted aquarium, and this is coupled to the fact that a tropical tank does not get cloudy, or need much attention.

As for myself, I was fascinated by the beauty of some tanks at an exhibition, and decided that I should definitely have to do something about it.

Having obtained a tank, I stocked it temporarily with cold-water fish, and waited patiently for someone to write an article in THE MODEL ENGINEER on how to make the necessary accessories for a tropical tank ; but I waited in vain. Eventually, I started some experiments myself, and the following are the results of my labours.

I shall describe the construction of heaters, thermostats, and aerating pumps, but I do not claim that they are the most efficient methods of doing the job, and I shall be pleased to hear from others who have laboured for the same results, but without the sarcasm that sometimes finds its way into such letters—I do not profess to be an expert.

Materials

Now, it is comparatively easy to design a piece of apparatus (sometimes), and equally simple to construct it ; but obtaining small quantities of special materials is often the fence that causes one to come unstuck. So it always has to be borne in mind, and sometimes brilliant ideas have to be abandoned only for this reason.

The first item required for a tropical aquarium, after the tank, is a heater, and in my own case this was simply solved for my first aquarium, which was quite small, as shown in Fig. 1.

Two wire-wound vitreous enamelled resistances were obtained from a " surplus " store, 2,500 ohms, 15 watts was the size chosen. With the metal clips removed they would just slide nicely into a 6 in. × $\frac{5}{8}$ in. " Pyrex " test tube. A suitable rubber bung had two 3/32 in. dia. holes drilled in it, and rubber flex wire pulled through ; I advise rubber for this job because plastic covering tends to soften under heat. The wires must be a tight fit in the holes, and in order to thread them through, about 3 in. of wire was bared, and then tinned ; this stiffened the wire so that it could be pushed through the bung, and the rubber-covered portion could then be pulled through.

In order to get sufficient wattage the two resistances were connected in parallel, one of the flex wires being joined to the top of one resistance, and the bottom of the other ; whilst the second lead was joined to the connections at the centre.

These resistances are hollow, so the leads can pass down the centre, and it is advisable to cover one of them with insulating beads because the insulation at this point will be destroyed by the heat.

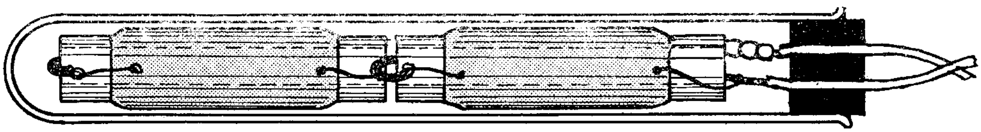


Fig. 1. The immersion heater

Having made the necessary connection, switch on for a few seconds to test, but as they are being over run when connected to 240-volt mains, do not leave them on for any length of time unless covered by water—in the tube, of course. If everything appears O.K. the bung can be pushed home, but before doing so heat the tube, and switch on the current for a few moments to heat up the resistances ; then, with the bottom of the test tube pointing upwards to trap the hot air, push in the bung. Allow it to get quite cool and try to push the bung in farther as the air inside contracts. If the above procedure is not carried out, it is likely that, as the resistances heat up and expand the air, the bung may be loosened, and when the heat is switched off a small amount of moisture will be drawn in which will turn to steam next time the thermostat " makes " ; and —Oh, boy ! talk about depth charges—I know !

Out of Sight

As I do not like to see these artificial accessories lying about in the aquarium I bury them in the sand, or behind a rock ; but in a small tank the sand is usually so shallow that the fish uncover at least some part of it ; and so I cemented sand to the tube before the resistances were put in. I found the best material for this job was " Alradite." The test tube was heated and rubbed over with the stick of this cement, and then plunged into dry sand and baked for the required time.

This type of heater is sufficient for tanks holding up to about six gallons, but will hardly be capable of dealing with larger tanks unless they are kept in a warm room ; and so for the larger tanks I use the following scheme. A wooden substage is built about 5 in. deep with four batten holders screwed to the inside to take ordinary electric lamps. These lamps are paired and wired in series, and this procedure not only allows a bigger variation

of wattage, but as the lamps are being greatly under-run they should last almost indefinitely.

Only one pair of lamps is connected to the thermostat as a safety device if the switch fails, —and even the best commercial types have been known to do so. With this arrangement the wattage of the unconnected lamps is so arranged that if the thermostat fails to " come on " they will give sufficient heat to keep the water to at least 65 deg., which most fish will be able to stand for some hours, or at least until the fault is noticed. On the other hand, the wattage of the connected lamps is adjusted so that if the switch fails to " cut out " the temperature will not rise over, say, 90 deg., which again is not likely to kill the fish. Using this arrangement it will most likely be necessary to alter the wattage in the autumn and spring ; so arrange a door in the substage so that the lamps can be changed without removing the tank. With this substage the aquarium itself is not spoiled by ancillary equipment.

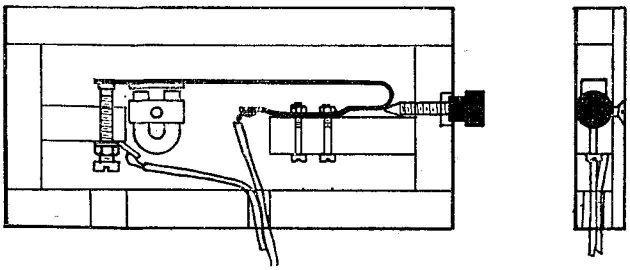


Fig. 2. The thermostat

The Thermostat

The biggest difficulty here is obtaining a small quantity of bi-metal strip. Most manufacturers understandably do not like supplying " sixpennorth " of this, and I feel that any dealer advertising this material would find a considerable demand.

Eventually, a friend in the electrical trade supplied me with some Invar-brass, ¼ in. wide and .01 in. thick. I should have preferred something about twice this thickness ; but beggars can't be choosers, and anyway, the thermostat in which it is embodied has given no trouble so far, so why worry ?

It was decided for the reasons aforestated that I would use an outside thermostat and not clutter up the tank, and Fig. 2 shows the general arrangement. It consists of an open-fronted shallow box which I made out of " Perspex " so that I could see if it was working properly. The sides are ⅜ in. × ⅜ in. strip, and the back cut from ⅛ in. sheet ; these are cemented together under pressure. Before cementing the bottom strip in position two ribs are cemented in place, and drilled and tapped to take a 6-B.A. contact screw, and the 8-B.A. fixing screws for the bi-metal strip. This strip is 4 in. long, and is bent as shown ; but before bending it, drill two clearance holes for the 8-B.A. fixing screws. On the long end of this strip solder your contact ; I used one cut off a " surplus " relay, and close behind is a small piece of transformer stamping. Obtain the " mate " of the relay contact, and solder it to the end of a 6-B.A. screw, and this goes into the tapped hole in the rib below the strip contact, and don't forget to put on the locknut and soldering tag for one of the mains connections. In order to make the " on " and " off " snappy, a small permanent magnet is fixed to the back by an 8-B.A. countersunk screw which screws into a hole tapped in a small brass clamping bar so that the height of the magnet can be adjusted, and this should be carried out so that the small piece of stamping just does *not* touch when the contacts " make."

A magnet out of a child's fishing game will do, or an old cobalt steel magnet can be annealed, and one cut from this, which, when hardened glass-hard can be remagnetised again sufficiently by placing it in contact with, say, a small " Eclipse " magnet, if an electro-magnet is not available. The second mains connection goes to the end of the bi-metal strip.

An adjusting screw with an insulated head is screwed through the side of the " Perspex " box in such a position that its tapered end bears on the bi-metal strip at the bottom of the bend. The strip should be assembled with the contacts apart at room temperature, as in the drawing, and then the adjusting screw screwed in until the contacts touch, and this adjustment tried out. For a quick test fill a shallow dish with warm water in which you have placed a thermometer, and cover with a sheet of glass, lay the thermostat on this ; by pouring cold, and hot water into the dish various settings can be quickly tried out, but remember it will take a minute or so for the thermostat to heat up, or cool down, to the new temperature.

A point I nearly forgot, and although pretty obvious, it is a mistake that can easily be made ; before bending the strip, test to see which way it bends when heated, and act accordingly.

When you are satisfied that the thermostat works, it can be cemented with " Bostic " to the glass of the tank so that it comes just below the water line, but I would advise you to stick it temporarily first with Scotch tape just to make certain everything is as it should be, especially as regards radio interference. Listen for it on your radio, and if you get a prolonged crackling, either the magnet needs adjusting or it is not strong enough. A suppressor can be fitted, but if this sparking is allowed to continue the contacts will not last long.

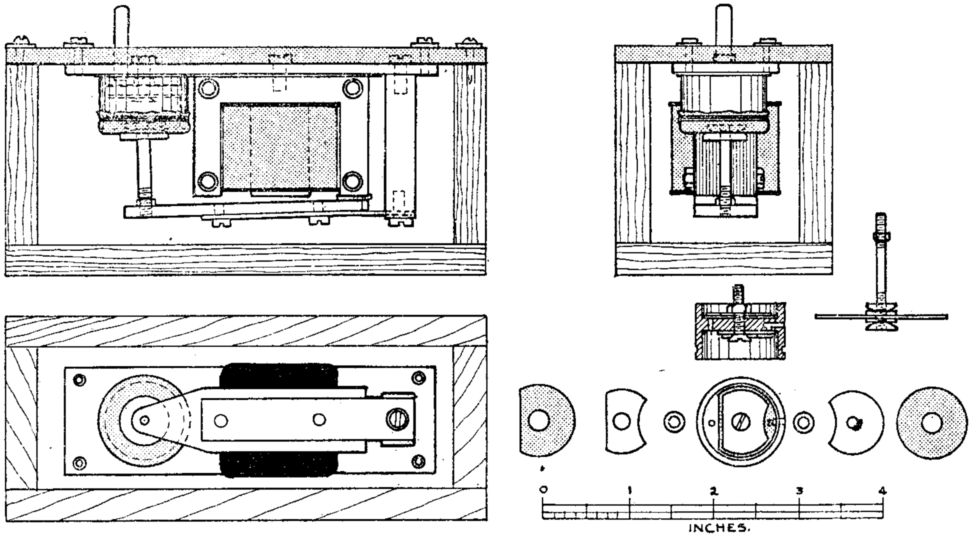


Fig. 3. General arrangement of vibrator, aerator, and details of pump and plunger

You can see if it is working properly ; the contacts should spring away about $\frac{1}{8}$ in. when it breaks and close with a snap when it comes within about 1/32 in. of the fixed contact.

The Vibrator Pump

This type of aerator pump is extremely simple to construct, and the principle is as follows : an a.c. electro-magnet causes a soft iron armature to vibrate at twice the frequency of the supply ; attached to the end of the armature is a rod which depresses a diaphragm of a pump ; it is as simple as that. A practical pump is shown in Fig. 3 and photograph No. 1 shows the prototype. The first thing to construct is the magnet, and this consists of " E " stampings for which No. 145 laminations

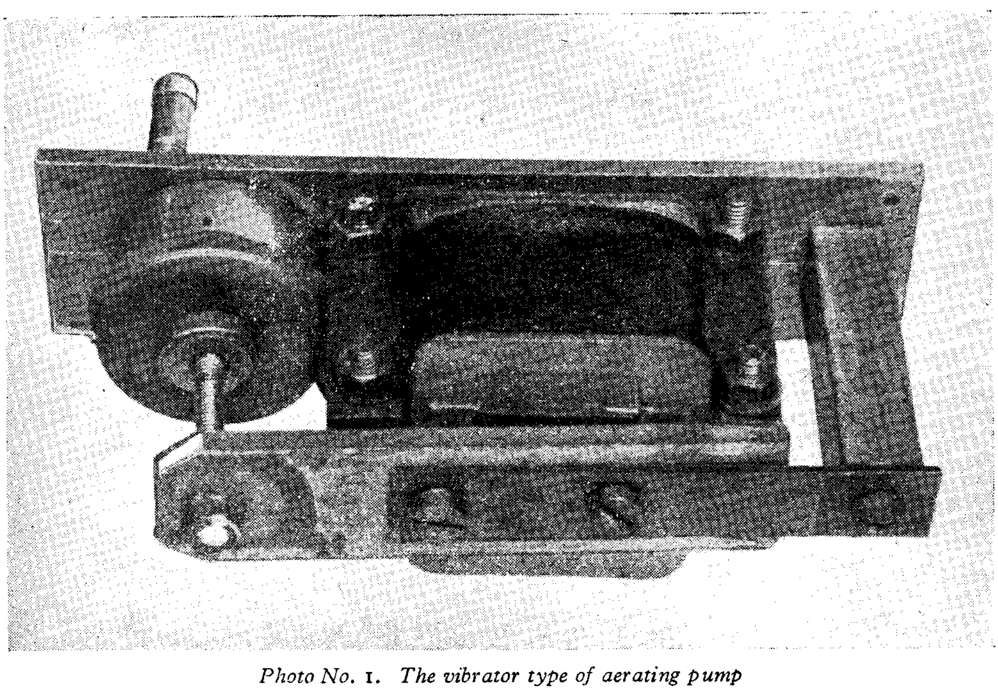


Photo No. 1. The vibrator type of aerating pump

are used (Geo. L. Scott & Co. Ltd., Cromwell Road, Ellesmere Port, Cheshire), a stack $\frac{5}{8}$ in. high gives a square core section, and a winding space of $\frac{5}{16}$ in. × 1 in. Using a bobbin constructed of 0.03 in. presspahn, it should be possible to wind at least 5,000 turns of 40-s.w.g. enamelled copper wire. The bobbin is glued together, mounted on a temporary wooden core through which is passed a $\frac{1}{4}$-in. bolt which is used to clamp on plywood end cheeks, and also as a means of holding the bobbin in the lathe chuck for winding.

Winding the Coil

Join on a short length of thin flex for the start, insulate the join with a piece of oiled silk or similar material and bring out through a hole drilled in the bobbin cheek. Wind on the turns as evenly as possible, interleaving each 500 turns with waxed paper ; I use the thin paper obtained from old Mansbridge type condensers ; finish with another length of flex, and bind with tape. If the reader has had no experience in winding such coils it is advised that he use the next size stamping, No. 187, which increases the length of the core and the winding space by $\frac{3}{16}$ in. As these stampings are transformer type, no holes will be stamped in the ends of the outer arms, and these will have to be drilled. It is not easy to drill a straight hole through stampings when clamped as a stack, and the way I suggest doing this is to make a jig and drill say a dozen at a time undersize. They are then assembled, knocked up square, clamped together and the hole opened out with a " D " bit.

Having completed the magnet, drill a $\frac{3}{16}$ in. tapping hole to a depth of $\frac{3}{8}$ in. edgewise into the centre of the core at the bottom—clamp them tightly whilst doing this—and tap $\frac{3}{16}$ in. Whit. This tapped hole is used to fix the magnet to the brass baseplate, which is $\frac{1}{8}$ in. thick. Shape the armature next, which can be of $\frac{1}{8}$-in. B.M.S. and fix to it, by means of 6-B.A. screws or suitable rivets, a length of 24-s.w.g. spring steel $\frac{1}{2}$ in. wide. A brass pillar, $\frac{5}{8}$ in. × $\frac{3}{8}$ in., is fixed to the baseplate by a 4-B.A. screw, but before doing this a rebate is filed or milled in the top to accommodate the armature spring, and to prevent it turning, the spring being secured to the top of the pillar by a 4-B.A. screw and washer.

The height of the pillar should be such that the back of the armature bears heavily on a piece of thin rubber—cycle tube—stuck to the rear pole ; the spring should be bent so that the front of the armature is clear of the front pole by about $\frac{1}{16}$ in.

A hole is drilled and tapped 4-B.A. to accommodate the diaphragm plunger, which consists of a 4-B.A. rod with special nuts made for the purpose, having a large diameter, slightly rounded mushroom shape, which clamp the rubber diaphragm of the pump between them ; thin leather washers intervening (see drawing). At this point the magnet may be tested to see that it vibrates properly, but don't worry about the noise which will be considerable, and will be greatly reduced when under load.

The diaphragm pump is turned from a short length of 1 in. dia. brass rod. Chuck a 2 in. length, bore a recess $\frac{3}{8}$ in. deep, $\frac{7}{8}$ in. dia., and then with the parting tool cut a groove $\frac{1}{16}$ in. from the top and about 1/32 in. deep on the ou' side, part off at $\frac{7}{8}$ in. Reverse in the chuck and bore a similar recess at this end $\frac{7}{8}$ in. dia. × $\frac{1}{4}$ in. deep ; then drill and tap a 4-B.A. hole down the centre of remaining web. Remove from the chuck, and drill a $\frac{1}{16}$ in. dia. hole about $\frac{1}{8}$ in. from the outer edge of the bore as shown ; this is the hole for the outlet valve, and goes right through the centre web of the barrel. A similar hole is drilled on the opposite side half way through the web, and a second hole drilled to meet this from the outside of the barrel (this is the inlet valve hole). See section, Fig. 3. Thin rubber washers are now cut from an old rubber glove, if you have one, slightly less than the inside diameter of the barrel and, out of the one to be fitted on diaphragm side, a small piece is trimmed off to miss the outlet valve hole. Holes, $\frac{1}{4}$ in. dia., are cut in the centre of these washers which are then cemented into the barrel with a spot of " Bostic," but left unstuck near the valve holes. As a safeguard to prevent these washers coming loose at a later date, specially shaped thin metal washers are clamped over them, see drawing, using the barrel fixing screw for the purpose. If these washers are tightened down on the rubber ones, I found the edges tended to cockle and lift, so small card washers were inserted in the holes in the centre of the rubber ones, and the pressure taken on these.

Use a countersunk fixing screw, otherwise its head will foul the end of the plunger. Drill a clearance hole in the baseplate, and by means of the fixing screw, clamp the barrel to the base ; making an airtight joint by inserting a piece of card, or rubber, between them ; but don't forget to cut a hole for the air outlet, which is a short length of brass tubing screwed into the base close to the fixing screw. Cut a diaphragm from cycle tube, pierce a small hole in the centre, and clamp between the special nuts, inserting thin leather washers between the nuts and the rubber.

Tie on the diaphragm with twine or wire, stretching slightly as you do so, but keeping the plunger central. Trim off surplus rubber, and pump is ready for test.

Temporarily clamp in the vice, armature downwards, and adjust length of plunger so that the diaphragm pulls the armature down slightly ; switch on the current, and the pump should work.

Faults

If the pump gives no air at all when a plain pipe is held just below the surface of the water, the valves are at fault and should be examined, but if it bubbles, but the volume is lacking, try adjusting the spring pressure, or the gap of the armature above the front pole. Try the result of pressing with finger on the front or the back of the armature, and the results should indicate where the trouble lies. Actually, the pump should deliver more air than is required for one tank, and the volume and the noise can be reduced by inserting a small piece of sponge rubber under the front gap.

The pump will still be noisy, and must be resiliently mounted as follows. Cut a small piece of thick rubber—flooring will do, and that can easily be obtained from under the bath, no one

will notice—this is secured to the brass baseplate by four 8-B.A. screws with oversize washers. This rubber is screwed to, and acts as, the top of a wooden box made with $\frac{3}{8}$ in. material.

The bottom of the box is covered with sponge rubber. The pump should now emit only a quiet hum, and is ready for use.

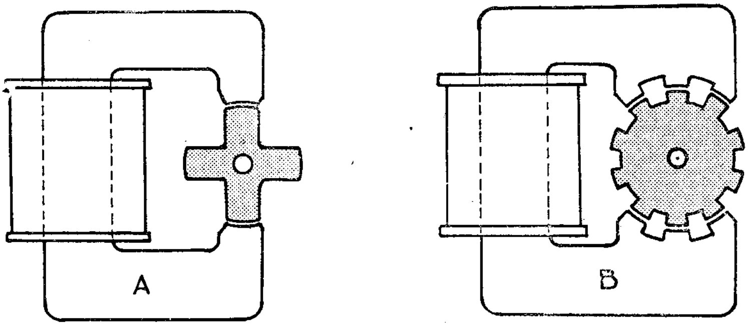


Fig. 4. The basic hysteresis motor

By the way, it is as well to cover the heads of all screws and nuts with a coating of shellac varnish to prevent them working loose.

The Motor Pump

In order to overcome the noise of the vibrator pump, some readers may wish to make a motor pump ; I did myself.

Now, high-speed motors are not very silent, at least not when they drive reduction gears to give the necessary pump speed unless they are very carefully designed and made ; so I looked round for some type of slow speed motor, but none were available except as clock motors, and these had not the necessary power. I therefore decided to scale up a clock motor if I could find a suitable design that did not require special stampings.

Hysteresis Motors

Now, all these clock motors, although appearing to differ greatly, are basically all designed on the same principle, and are hysteresis motors. Hysteresis is the property of a metal to resist magnetic changes, some metals, such as soft iron, resist less than, say, cobalt steel, and it can also be called the reluctance of a metal to follow a magnetising current, and is a property of all iron and steels to a greater or lesser degree, creating a lag—which may be only slight—between the magnetising current in the coil and the flux that it produces in the core.

The way in which this can be used in an electric motor can be demonstrated by referring to Fig. 4A. This shows an electric magnet, and, pivoted in the flux path between the two poles, is a cross of iron, preferably magnetic steel. If a current is passed through the magnetising coil in such a direction as to make the top pole north, the arm of the cross immediately below it will be magnetised south, and vice-versa with the bottom pole.

If now the current in the magnetising coil is reversed, changing the polarity of the poles, the arm of the cross being of ordinary magnetic steel, they will remain magnetised for a fraction of a time in the same polarity, and will be repelled by the field magnets which are of low hysteresis metal and will rotate 90 deg. so that the next arm is now under the pole. Which way the cross rotates is anybody's guess.

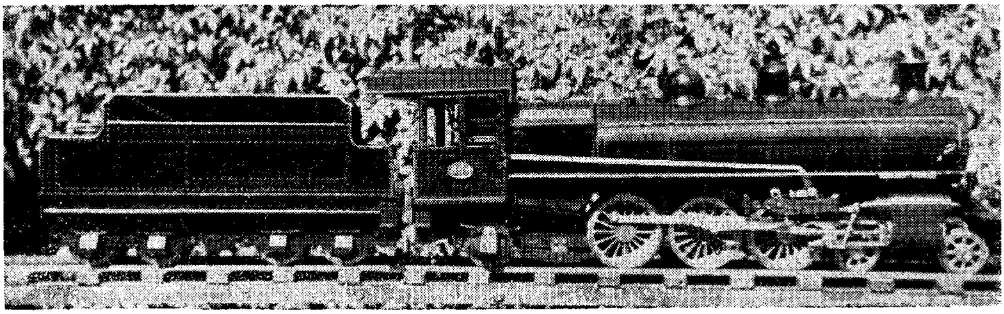
If the switch had again been reversed just as the second arm of the cross reached the pole centre, the flywheel effect would have caused it to continue to rotate in the same direction ; and if the reversing switch of the electro-magnet is flipped backwards and forwards, the rotation will continue in step. Flipping switches is a tiring job, so if we connect the magnetising coil to the a.c. mains the direction of the current will be automatically changed 50 times per second, but the cross will not start revolving because before it has time to commence to move the direction of the current will have changed.

If, however, we spin the cross—or rotor as it is usually called—somewhere near synchronous speed, it will then continue to rotate exactly in step with the frequency of the supply, moving two arms of the rotor for every cycle, i.e. 1,500 r.p.m., or if we increased the number of arms to eight on the rotor then it would revolve at 750 r.p.m. We can go on adding arms until we obtain as slow a speed as we require, or until the arms, or teeth as they could be then called, are so small that they are no longer efficient as an individual pole.

When we have a large number of teeth on the rotor, and if we use a high flux density across the gap, it will be found that the rotor tends to lock across the teeth ; this tendency can be considerably reduced by increasing the size of the pole face, and distributing the flux over a number of teeth as shown in Fig. 4B which now begins to look something like a clock motor. A second method that helps to overcome the locking is to fit a flywheel to the rotor shaft, and often both these expedients are used.

Looking once again for a suitable design for a pump motor, I found that practically every type required special stampings, and if these stampings were available they would only be obtainable in sizes suitable for the small clock motors. However, searching farther I found something that could be constructed from simple stampings, originally a design for a synchronous motor used to drive turret clocks.

(*To be continued*)



Variety in Our Hobby

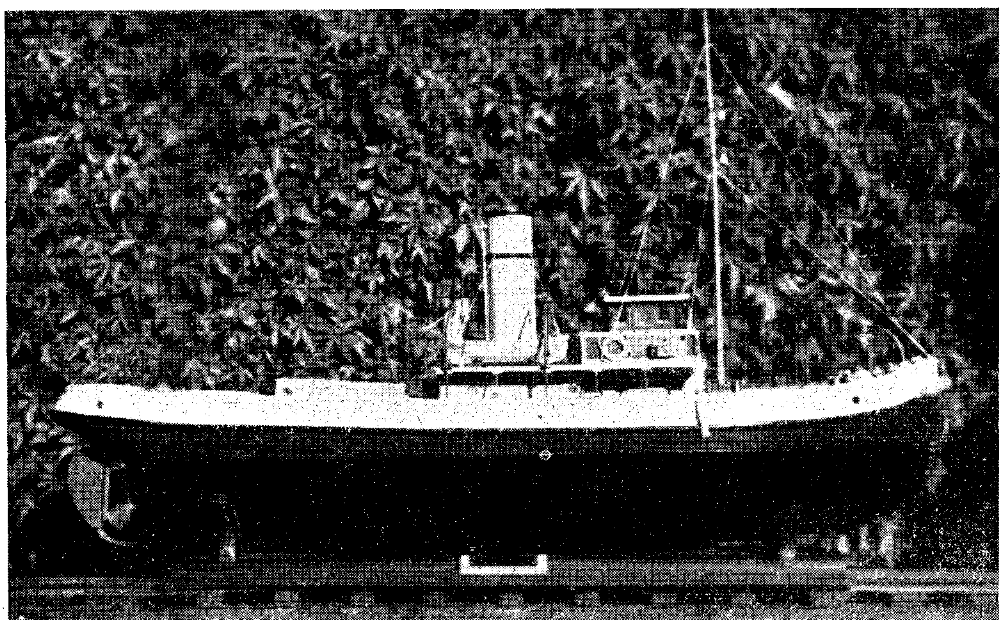
WE have received an interesting letter from Mr. James A. Lang, of Mount Lawley, Western Australia, in which he expresses a preference for variety in modelling. He certainly exemplifies his ideal, judging by the photographs which we reproduce herewith.

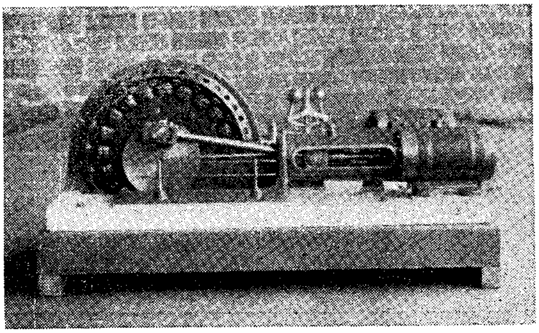
Mr. Lang first became a reader of THE MODEL ENGINEER in 1908, since when he has been a regular subscriber, and he has been a confirmed model maker for more than forty years. He is president of the Perth (Australia) Model Engineers' Society which has more than fifty members, and is engaged in the engineering industry as chief engineer and director of two companies in control of two factories.

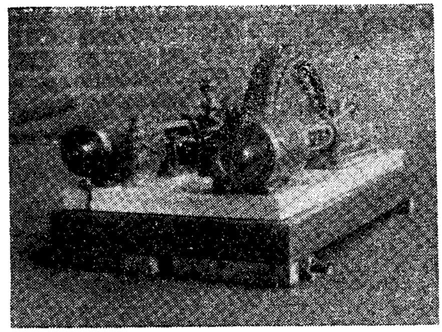
With this background, Mr. Lang suggests that model engineers might extend their interest and constructive abilities to a number of subjects which, at present, do not seem to attract many enthusiasts. Power-station plant contains a wealth of variety in the types and designs of the last fifty years. It covers slow-speed horizontal cross-compound engines, direct-coupled to generators, with various valve-gears; high-speed vertical sets such as Bellis & Morcombe, Edgar Allan and others made, with close attention to details and valve-gear, turbo-generator sets, etc. Then there is a wide choice of mill engines of all types, with Meyer, Corliss, drop-valve and other motions. And there are the steam and electric winding engines used for operating the cages in mines; these would make spectacular working models, especially if enhanced by the addition of model pit-head gear.

Referring to the photographs sent with his letter, and reproduced on this and the opposite page, Mr. Lang writes :—

"I have completed models of a West Australian 'P' Class locomotive; Tugboat *Uco*; A.E.G. Curtis 2-stage turbo with direct-

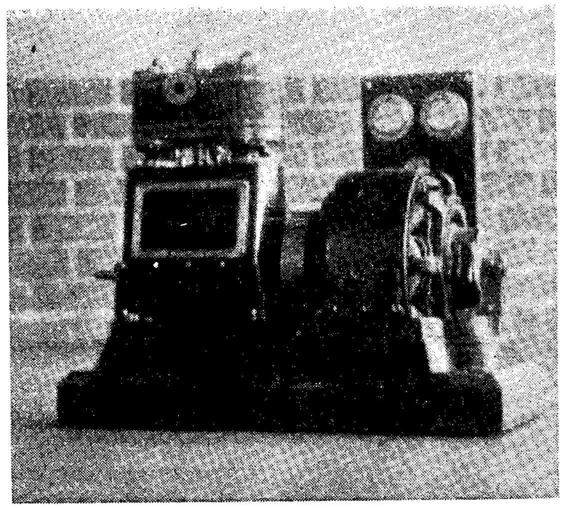


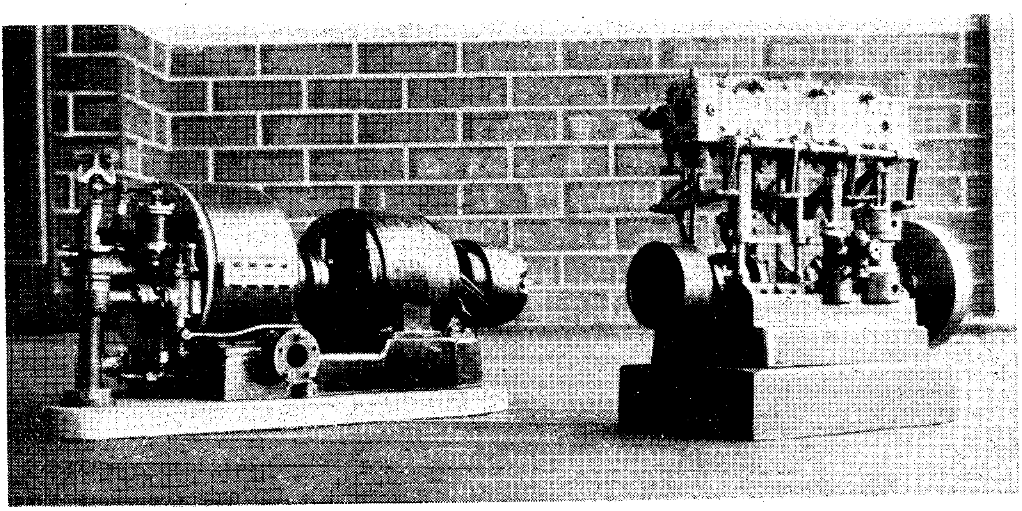




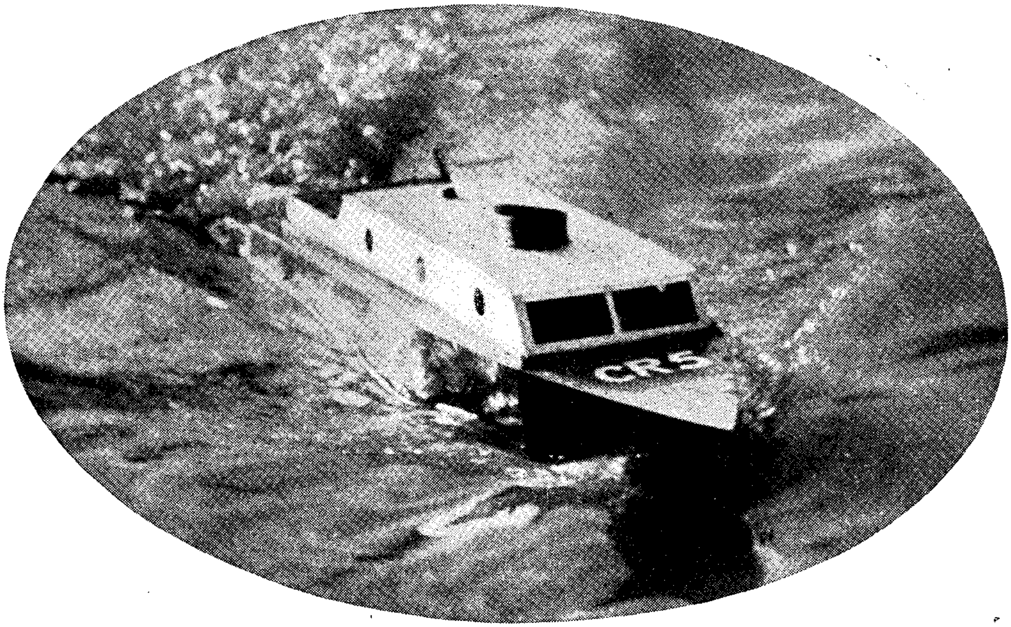
coupled alternator and overhung exciter; Bellis-Morcombe direct-coupled d.c. generator of 8 poles, valve-gear true to prototype; Stuart triple-expansion marine engine; also, a fairly close model of a Tosi (Italian) power station alternator. The latter plant has cross-compound cylinders of $\frac{15}{16}$ in. × $2\frac{1}{16}$ in. × $2\frac{1}{2}$ in. Meyer valve-gear is fitted and controlled by the governor. The original had drop-valves on H.P., which was beyond me. I had purposely governed the engine at 240 revs., which looked imposing and gives a frequency of 40 cycles, which is standard in this State.

"Several boilers with feed pumps and a condensing set have been completed. With this collection I intend to display a complete power station. I have also made a number of commercial models, including a working model of a wire and netting factory, and a very useful grandfather clock with chimes."





The Kingsmere M.P.B.C. Regatta



Mr. Duncan's steam launch " Zoe " (Croydon) in the steering competition

ONE of the last regattas of a most eventful season for model power boat enthusiasts, took place at the Kingsmere pond on Putney Heath, London, S.W., when the Kingsmere M.P.B.C. held their maiden regatta on a recent Sunday.

In spite of very heavy winds, which at first sight would seem to put speed craft at a disadvantage, a new record for Class " B " was set-up by G. Lines's *Sparky II* at 64.6 m.p.h. The 60 m.p.h. mark was also exceeded by G. Stone with *Lady Babs II* in the " C " Restricted race. This represents the best British regatta performance by this boat, and breaks a run of bad luck this year for her owner.

The regatta opened with a 5-lap race for Class " A " boats, and some seven boats contested the honours. Among them were two entries from B. Miles of the home club. *Barracuda* and *Typhoon*. Neither of these well-known boats were able to finish the course, however, and the best speed was put up by A. Cockman's flash steamer *Ifit* 7 with a run of 45.45 m.p.h.

W. Parris with *Wasp III* took second place and was followed closely by E. Walker with *Gilda*. Other interesting boats in this event were *Gay Gremlin* owned by E. Coward and *Zipp* by N. Fort, but both suffered from teething troubles.

Luckily for the " C " and " C " Restricted boats which came on next, the high winds did not roughen the water surface unduly, but several craft flipped over backwards with its assistance. The distance for this race was 300 yd., but competitors were allowed more than ½ lap start if desired so that a good flying start was gained. G. Stone (Kingsmere) running *Lady Babs II* and *Lady Cynthia* had bad luck with the latter craft when it dived under on both runs ; *Lady Babs II*, however, achieved 62.6 m.p.h. on one run to win easily the " C " Restricted prize, the next best being N. Ridley (S. London) with *Maree*, 46.9 m.p.h. E. Clare (Derby), with *Imshi*, recorded 45.1 on the first run which unfortunately ended in a capsize, the damage sustained preventing a second attempt.

The next race was also over 300 yd. but for Class " B " hydroplanes. The entry was small, but nevertheless, this race provided the fastest speed of the day. After several false starts, G. Lines managed to get *Sparky II* away, and an amazing performance resulted ; 64.6 m.p.h. was the average for the 3 laps ! This will be claimed as an official record, and it is believed, that this speed is also very close to the American record for 15 c.c. hydroplanes.

F. Jutton's flash steamer *Vesta II* also managed one good run, but below this boat's best speed.

Last of the speed events, a 3-lap Class " D " race brought forth the largest entry yet seen for this class and also the best speeds yet seen at a regatta for these little craft.

M. Karslake (Kingsmere), running a new boat *Baz*, recorded 37.8 m.p.h. on one run, to win the event, closely followed by E. Woodley (Enfield)

35.6 m.p.h., and F. Walton (Kingsmere), 34.9 m.p.h. A. Sherwood (Victoria) managed 32 m.p.h. with the diminutive *Jinx II*, and several other boats were near the 30 m.p.h. mark.

For the straight-running boats there were two events: a Steering Competition and a Team Race. Some seventeen boats took part in the former and some reasonable scores were made considering the cross-wind prevailing. E. Walker (Kingsmere), with *Coron*, was the winner with 9 points; J. Benson (Blackheath), with *Comet*, ran second with 8 points and third place went to A. Squires (Kingsmere), with *Comet III*, after a re-run with A. Rayman (Blackheath). In the team relay race, four teams of three took part, and the Blackheath team, Messrs. Rayman, Benson and Falconer, just beat the Kingsmere team, consisting of Messrs. Squires, Curtis and Walker. This event causes much excitement among the various competitors, especially when E. Vanner's *Leda III* decided to take a trip down the lake, instead of returning to the team.

A study in concentration: Messrs. Vanner and Fermier officiating as timekeepers

Results

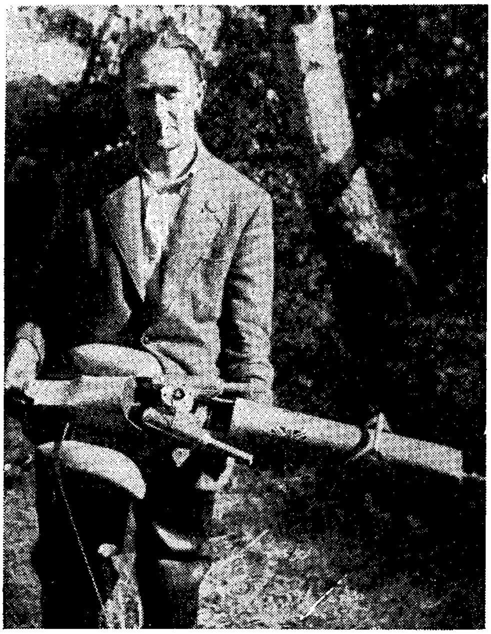
500 *yd. Class "A" Race.*—1. A. Cockman (Victoria), *Ifit 7*: 45.45 m.p.h. 2. W. Parris (S. London), *Wasp III*: 36.5 m.p.h.

300 *yd. "C" Restricted Race.*—1. G. Stone (Kingsmere), *Lady Babs II*: 62.6 m.p.h. 2. N. Ridley (S. London), *Maree*: 46.9 m.p.h.

300 *yd. Class "C" Race*—1. R. Phillips (S. London), *Foz*: 47.2 m.p.h. 2. B. Miles (Kingsmere), *Dragonfly*: 38 m.p.h.

300 *yd. Class "B" Race*—1. G. Lines (Orpington), *Sparky II*: 64.6 m.p.h. 2. F. Jutton (Guildford), *Vesta II*: 48.7 m.p.h.

A "D" class exponent, Mr. Hancock (Kingsmere) picks up some tips on big flash steamers from Mr. Cockman (Victoria)



Mr. G. Lines (Orpington) with "Sparky II," damaged after diving at over 60 m.p.h.

Mr. E. J. Newton (Kingsmere) with a new boat propelled by a "split single" c.i. engine

300 *yd. Class "D" Race*—1. M. Karslake (Kingsmere), *Buz* : 37.8 m.p.h. 2. E. Woodley (Enfield), *ED2* : 35.6 m.p.h.

Steering Competition—1. E. Walker (Kingsmere), *Coron* : 9 pts. 2. J. Benson (Blackheath), *Comet* : 8 pts. 3. A. Squires (Kingsmere), *Comet III* : 6 pts.

Team Relay Race—1. Blackheath (A. Rayman, J. Benson, A. Falconer) : 1 min. 24 sec. 2. Kingsmere (A. Squires, E. Walker, F. Curtis) : 1 min. 35 sec.

Meteor Model Race Car Club

The above club will be holding its annual open event on Sunday, November 12th, in the canteen of Messrs. Rist Wires & Cables Ltd., Milehouse, Newcastle, Staffs. Because of the high speeds obtained today and the small track available, in the interests of safety the club has decided to run the 10 c.c. class only as an all-British event. We feel sure that it will be appreciated that this is done in the best interests of all concerned. In a sporting gesture F. G. Buck has decided that in view of these circumstances, *Topsy* will not be running.

There will be three classes of entry as follows :—

Class 1.—Cars up to 2.5 c.c.

Class 2.—Cars over 2.5 c.c. and up to 5 c.c.

Class 3.—*All British* cars over 5 c.c. and up to 10 c.c.

The following prizes will be awarded to the fastest cars :—

Class 1.—1st, 2nd, 3rd prizes.

Class 2.—(Open) 1st and 2nd. (British) 1st, 2nd and 3rd prizes.

Class 3.—*British* 1st, 2nd and 3rd prizes.

The track will be available for practice from 10.30 a.m. Racing will commence at 1.30 p.m. prompt, beginning with the 2.5 c.c. class ; the best of two runs will be taken if possible. Entries should be sent in as soon as possible to enable the programmes to be completed.

Hon. Secretary : H. S. Howlett, "Richmond," Abbots Way, Westlands, Newcastle, Staffs.

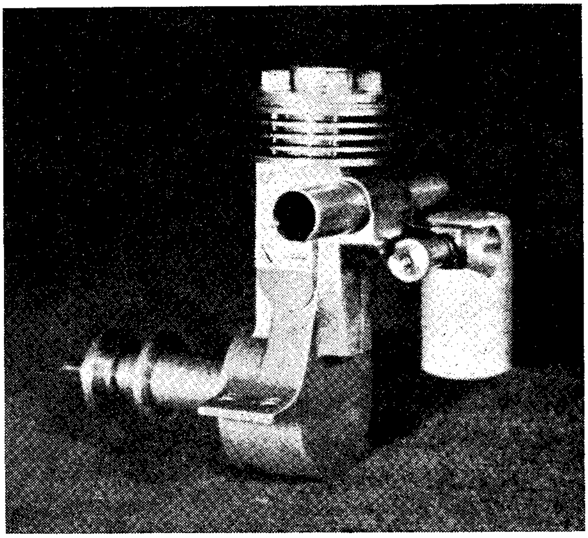
Building a 1.9 c.c. Diesel

by G. D. Schepel and J. Buwalda (Holland)

THE motor described in this article is of the compression-igntion type. It really is a normal two-cycle motor without electric ignition, in which the very high compression ignites the fuel.

It was first made in Switzerland. In 1944 we saw a photograph of the Dyno in a German illustrated airplane journal and because materials for electric ignition were not to be had and very difficult to make, we tried to make such a motor.

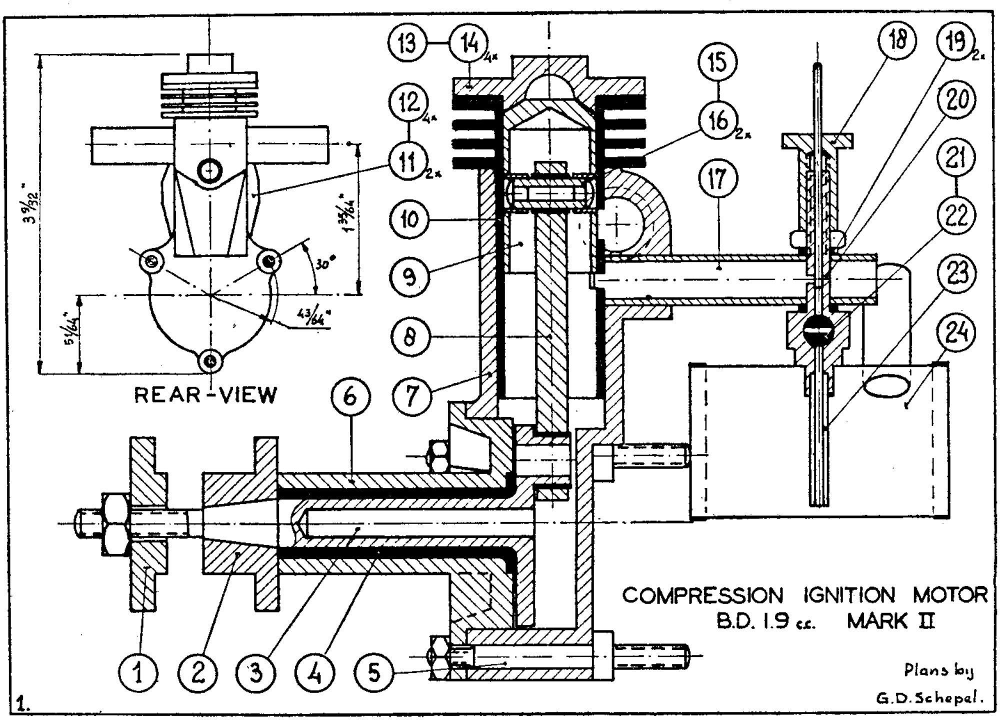
This unit is the result of many years of experiments and we can say it is a good motor and runs very well. We built it into boats and airplanes, and in both cases it gave full satisfaction.



Because factory-built motors were not available in our country we described an earlier type of this motor in a Dutch modelbuilders' journal, and we shall now try to describe a home specification :—

Bore, 15/32 in. ; Stroke, $\frac{5}{8}$ in. ; Displacement, 1.9 c.c. ; Weight, complete with tank and propeller, $5\frac{1}{2}$ oz. ; Overall height, 3 5/32 in. ; Dual exhaust ; Radial mounting or beam mounting.

It swings a propeller of 9 in. diameter at 5,500 r.p.m., both clockwise and counter



1.

clockwise. It flies a model up to 4 ft. span.

This motor seems to be very easy to make but we say beforehand that the grade of precision must be very high, especially of cylinder and

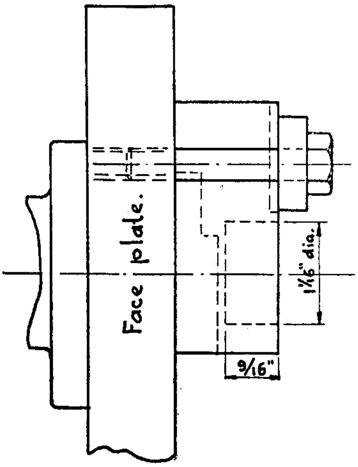


Fig. 1

piston ; therefore, all dimensions must be carefully observed.

Finish of the surface is :—

V = coarse
VV = normal
VVV = smooth
VVV = very smooth

The materials used must be of good quality as indicated in text. The only machine equipment required is a small lathe with 8 in. swing. The

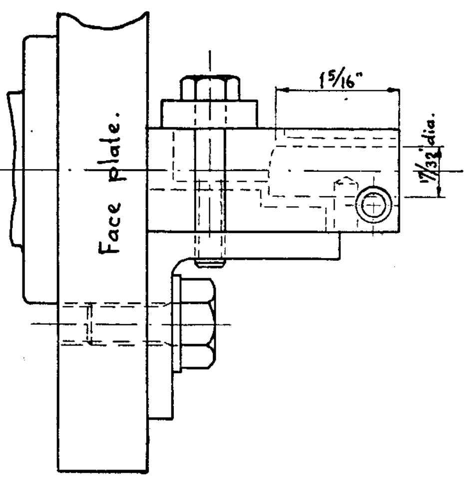


Fig. 2

lathe accessories necessary, with the exception of the usual cutters and toolholders, are tailstock chuck for drilling and some drills. All drilling can be handled in the lathe but a drill-press will be very helpful.

Construction

From the drawing of the crankcase it can be seen that this is a fine piece of workmanship. It has been constructed in such a way that part of the cylinder is surrounded by the upper part of the crankcase for greater strength, in view of the great forces which arise from the high compression. This section comprises the two bypasses, intake tube and exhaust.

The crankcase can be made from a piece of electron or dural (al. alloy) 1 1/16 in. × 1 7/16 in. × 2 41/64 in. The crankcase can also be cast, in which case a steel casting mould is made. In our case we also made a steel mould and the workpiece looked very fine, but it is much more work !

We begin to mark off the places where crankshaft, cylinder and the three mounting holes are to come and bore the part where the crankshaft is going to turn. For this purpose we mount it in a four-jaw chuck or against a faceplate (see Fig. 1). Before boring the place for the cylinder we mark off and bore the places for intake tube (¼ in. diameter and ½ in. depth) and exhaust pipes

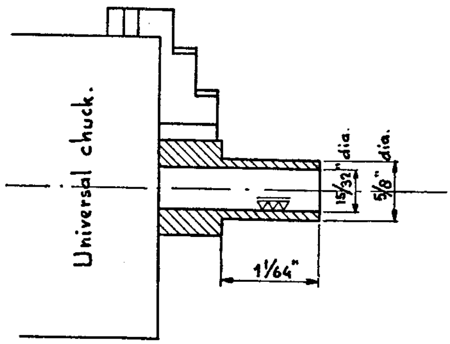


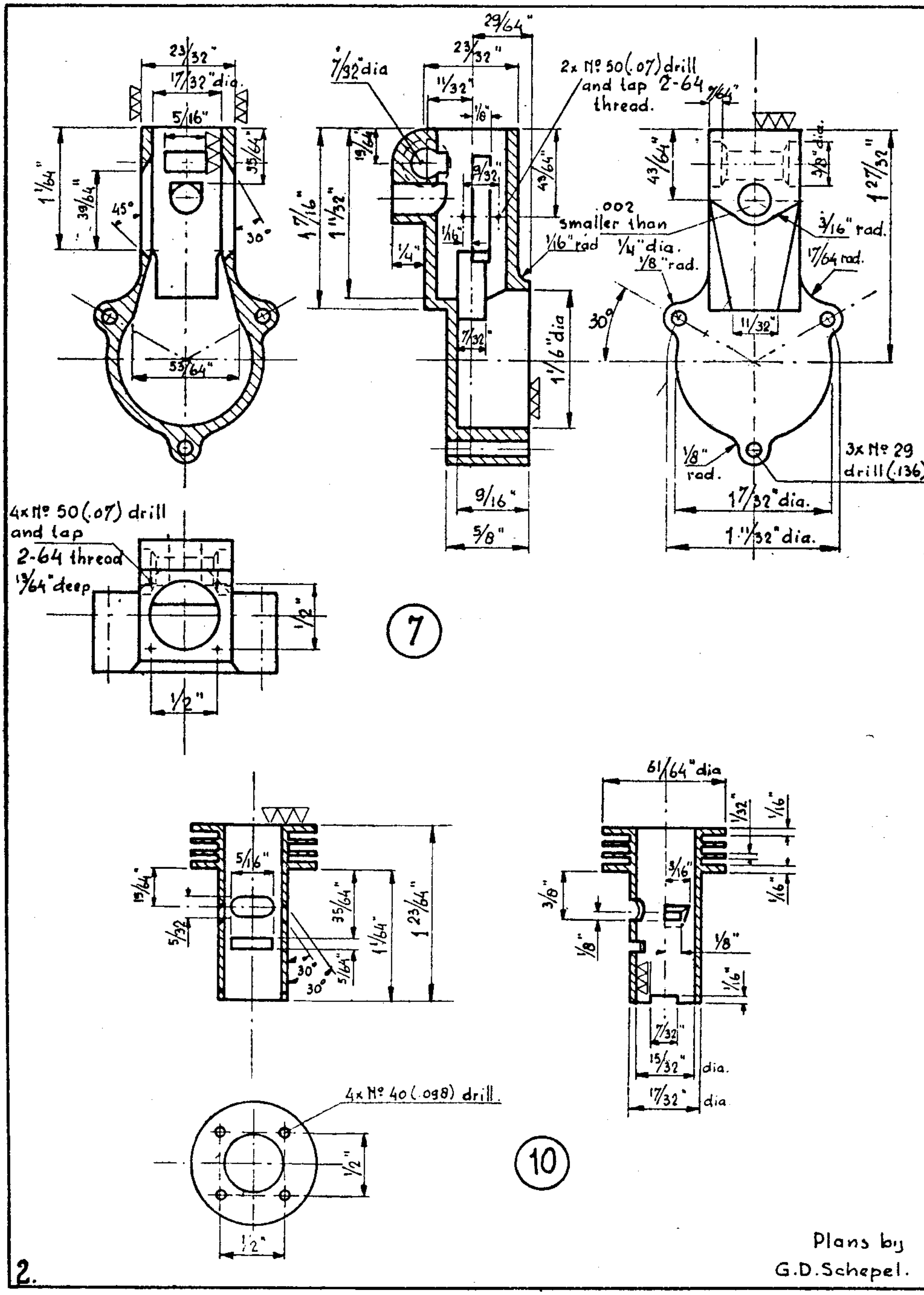
Fig. 3

(7/32 in. diameter). After this we bore both sides of the 7/32 in. hole to ⅜ in. diameter with a depth of 7/64 in. Now we can bore and turn out the place for the cylinder (see Fig. 2). Take care that the measurement 1 5/16 in., is accurate !

Next file out the 7/32 in. exhaust hole to 5/16 in. × 5/32 in. and the intake hole upwards to an angled section. Now we press in the intake tube and both exhaust pipes which are chamfered on one side. After we have pressed in the exhaust pipes we file out backwards the 7/32 in. hole to the inner diameter of the pipes. Now you can work according to the drawing with the exception of the tapholes with 2-64 thread for mounting the cylinder. The position of these can best be determined by means of the cylinder when this is ready. Bore and tap through the upper side of the exhaust pipe. When tapping aluminium, use turpentine oil. File down the superfluous material to the outlines.

The cylinder can be made of any kind of unshrinkable tool steel or chrome-nickel steel (motor-car axle).

When you have a lathe which is not too small, you can turn the complete cylinder in one operation. Watch carefully that the cylinder is reamed



before it is turned to 17/32 in. diameter. Before reaming, the outer diameter must be about $\frac{5}{8}$ in., otherwise the cylinder will not be rigid enough. Should your lathe be too small for this, the best procedure is as follows : saw a piece of steel to the correct length, mount in three-jaw chuck, bore, turn, ream and polish (see Fig. 3). The polishing is done with a bronze or cast-iron lap (see Fig. 4). The thin rod is slightly tapered (13/64 in. to 7/32 in. diameter at a length of $\pm$ $1\frac{3}{16}$ in.

We move the lap by hand to and fro through the cylinder, using the finest polishing compound obtainable. When this is done we mount the cylinder on a mandrel between the centres after which the cooling fins are cut.

The oiled mandrel, which must fit tightly, is driven into the cylinder (see Fig. 5). To cut the fins, we use a parting tool placed inverted and

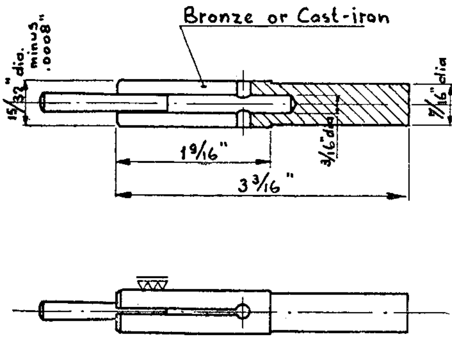


Fig. 4

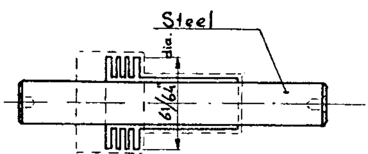


Fig. 5

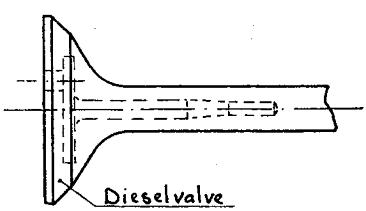


Fig. 6

reverse the lathe. This arrangement prevents trouble from vibration and dislocation of the work. When the cylinder is turned in one operation the same method of cutting the fins can be applied. If you have a toolpost grinder you can carefully grind the cylinder but it must be a very accurate job. Take care that when turning an extra 0.006 in. to 0.008 in. is left for grinding. In our case we chrome-plated the cylinder, which is very resistant to wear. Before hardening, the ports had to be filed out. Carefully note the position of the two bypass ports ; observe the drawing which shows that the ports are placed obliquely forwards and upwards.

The crankshaft is also made of a piece of very good tough steel. Chrome-nickel steel is very suitable. In our case we used an old valve of a large diesel-motor (Fig. 6). It takes a lot of work to turn the crankshaft out of one piece of steel but it is necessary because a built-up crankshaft is not strong enough. We begin to flatten the ends and drill small centreholes with a centre countersink drill. Next, the piece of steel is set between the centres and cut down along the whole length to the outer diameter of 13/64 in. Now we can

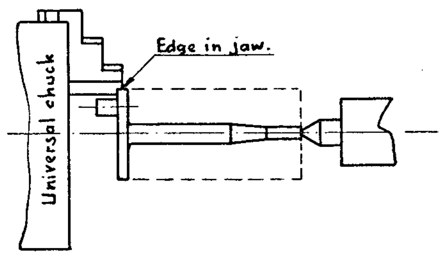


Fig. 7

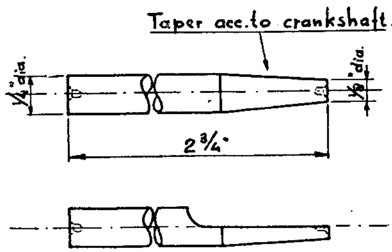


Fig. 8

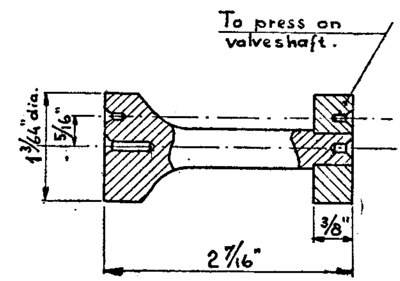
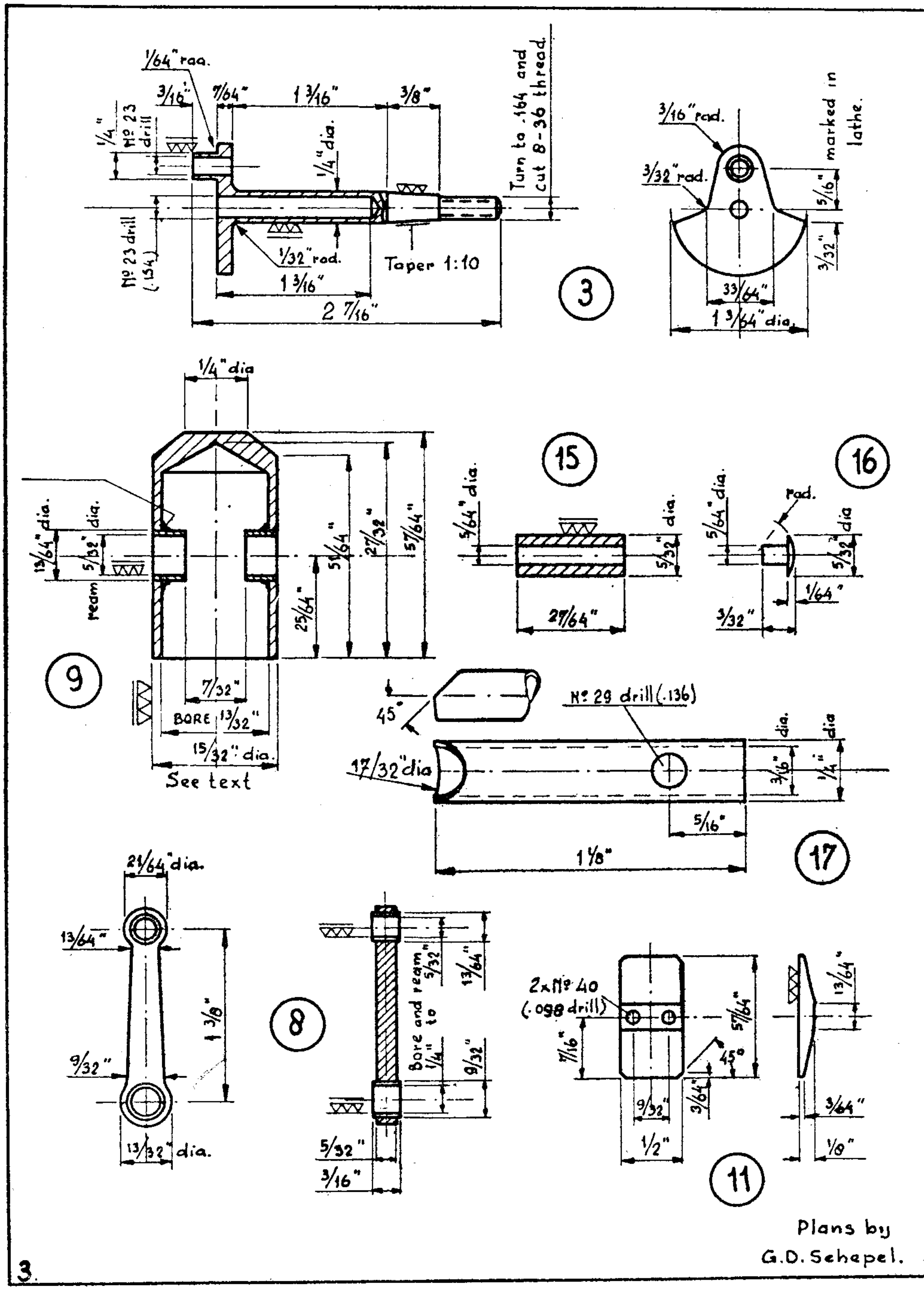


Fig. 9

mark off and drill the two other centre holes These holes must be situated on one line parallel to the centre-line for turning the crankpin. We can place the crankpin-end of the piece of work in the three-jaw chuck and the shaft-end in the centre of the tailstock (see Fig. 7). This is only possible when the chuck does not wobble ! A sharp angle at these places inevitably causes fractures. Cut the thread on the shaft in the lathe.

Now we cut the tapered end of the crankshaft : just after we make a cannon drill out of a piece of silver-steel so that it has the same taper as the crankshaft cone. This is done by placing the piece of steel between the centres. We file down one side of the cannon drill up to the centre-line and harden it (see Fig. 8). With this drill we ream the hole in the driving disc.

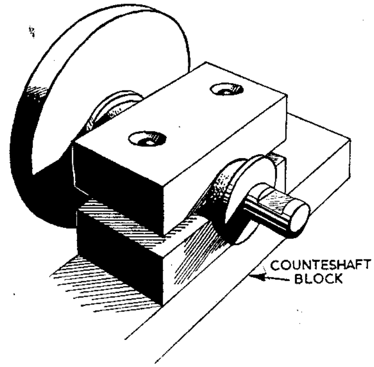


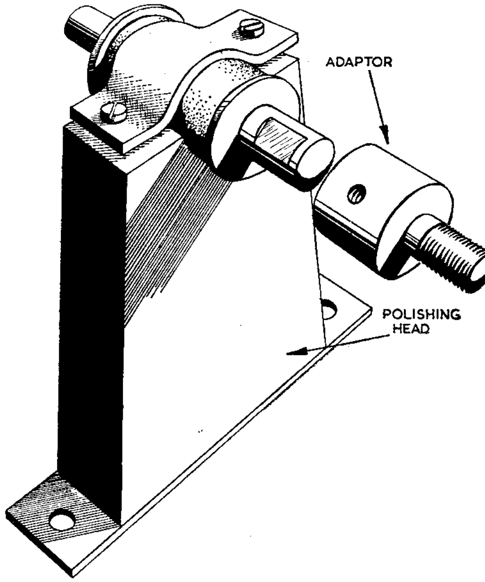
When we make a crankshaft out of a valve we cut it down to an outer diameter of 1 3/64 in. and $2\frac{7}{16}$ in. long. To cut the crank in between centres, we press a disc on to the shaft (see Fig. 9). When the crankpin is turned we cut down the disc. Do not strike! The rest of the work is the same as above.

(To be continued)

An Inexpensive Ball-Bearing Unit

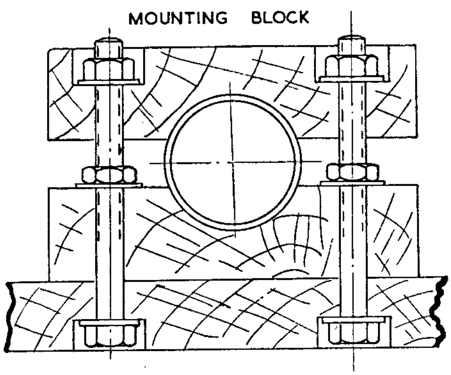
by "Libra"





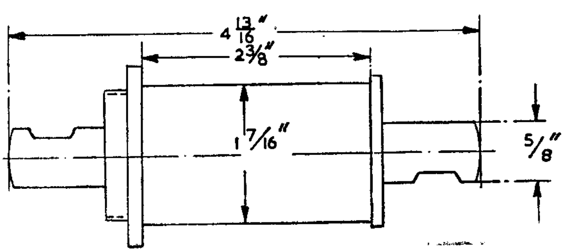
READERS requiring a ball-bearing counter shaft for a lathe, saw or other power-driven tool, may be interested in a completely self-contained unit which is made for use in the bottom brackets of pedal cycles. All the parts of this unit are replaceable and it requires no work on it, apart from mounting on a suitable block and possibly providing a cap for the oil aperture.

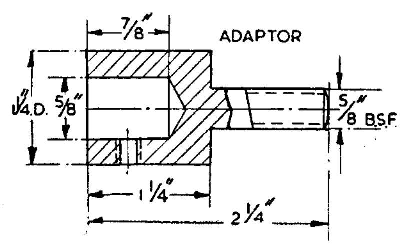
The spindle, which is hard, has flats milled on it to take the crank cotter-pins on a cycle, and these flats conveniently take grub-screws securing pulleys or other fittings when the unit is used in the workshop.



I recently used one of these units mounted on a wooden block, as shown in the sketches, and screwed to a baseboard which also supported a 3,000 r.p.m. motor. By using a 3-in. pulley on the motor shaft and a 9-in. one on the counter shaft, I was able to obtain the speed I required.

Another use for the unit is suggested. Mounted as shown, a suitable adaptor can be made to fit the spindle, making a light polishing-head. Further uses will suggest themselves to the reader and at something less than 5s. each these units prove well worth while.



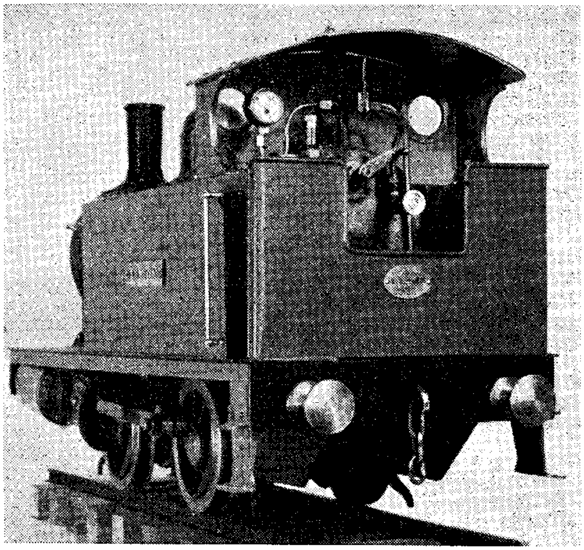


"L.B.S.C.'s" Lobby Chat

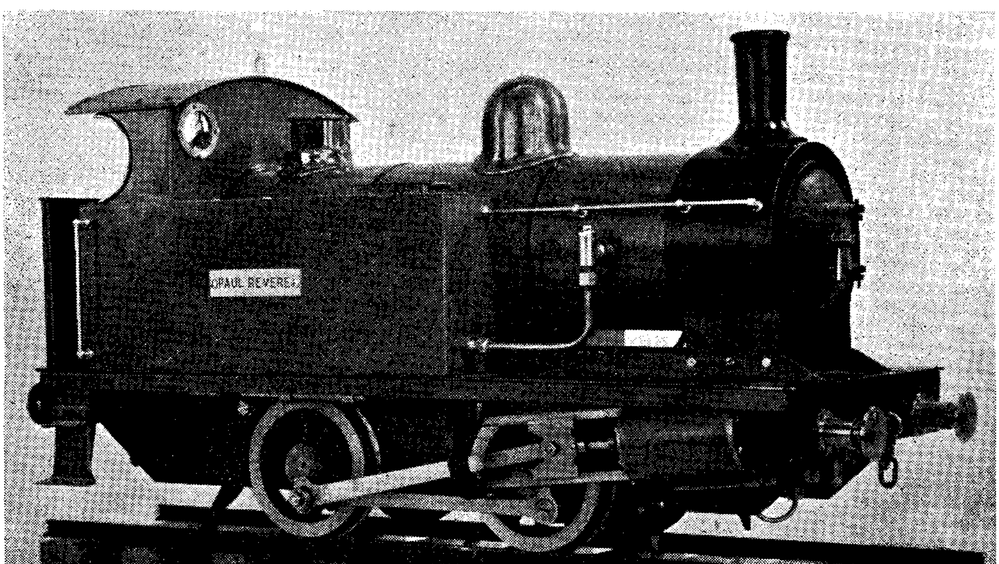
The "Tin Lizzie" of the Locomotive World

JUDGING from correspondence received, and from photographs which have come to hand "from anywhere and everywhere," it would appear that the most popular design for a 3½-in. gauge locomotive, that has so far appeared in these notes, was the little 0-4-0 tank *Juliet*. The number of engines built to the instructions must be well over four figures, if sales of castings and material are anything to go by. In addition to locomotives built from purchased castings, some have been made up from stock oddments, and in other cases—especially in out-of-the-way places where supplies were difficult to obtain — builders have either made their own castings, or made patterns and obtained castings from any convenient local source of supply. Some have been made without castings at all; I know of at least two, with wheels turned from stub ends of steel shafting. In another case the wheels were made from pulleys taken from a discarded snatch-block. One was built at sea, from odds and ends, the cylinders being carved out of a chunk of solid bronze; the boiler was made from bits of copper steam pipe ⅛ in. thick, so it is a pretty safe bet that *Mermaid* won't blow up!

The reason for *Juliet's* popularity is not far to seek; she is very nearly the rockbottom of simplicity, with no frills or fallals, so



"Neat and tidy"



A fine job by Mr. N. Burtt

that the rawest tyro could make a success of her at first shot. She costs little for the wherewithal to build her, and above all, the job is a quick one. Interest wanes when the work is spun out over years ; when there is a chance of getting the wheels turning quickly (in more senses than one !) there is an incentive to slap into the job. I should estimate that about 95 per cent. of the followers of these notes, build a locomotive with the definite idea of running it when completed ; and the sooner they get her on the road, the better they are pleased. Only just recently, time of writing, a new reader wrote to me and said he wanted to build *Pamela*, but was afraid that being a slow worker, and limited for spare time, he might lose interest long before the engine was ready to take the road. Could I therefore recommend him to a simpler job, which had already been described, and for which blueprints, castings and material were available ; he wanted to go right ahead, and not wait for instalments, otherwise he might have built *Tich*. I introduced him to *Juliet*. Result—he is getting busy on that engine right away, and says that as soon as she is ready to run, he will lay a line for her, after which he will start on his original first love *Pamela*. He says that building *Juliet* will serve a twofold purpose, viz. give him something to stimulate his efforts on the larger engine, by driving the smaller one, and also the experience gained in building *Juliet* will stand in good service on the *Pamela* job, which is, of course, sound reasoning. A few of my correspondents say they like building an engine for the kick they get out of the actual job, following the notes and finding the assembly fitting together like the bits of a jig-saw puzzle ; and are usually sorry when the job is completed. Well, the remedy for that, is in their own hands—they can always build another engine, or build two or more "in parallel," as our Milly Amp friends would say. At one time I built "quads," but though all sisters, they weren't very much alike !

A Fine North American Example

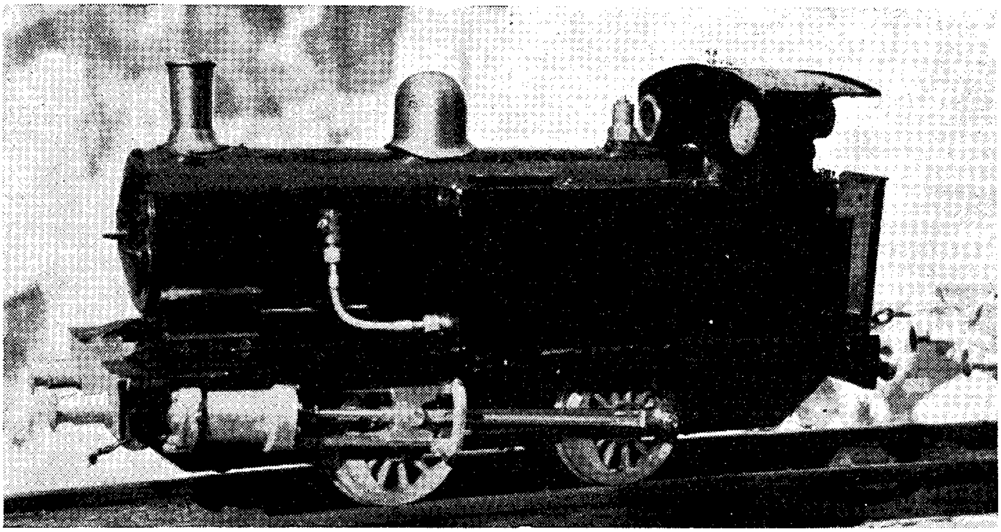
Here are two views of a fine *Juliet* type engine built by Mr. Nelson Burtt, of Sharon, Mass., U.S.A., whose *Petrolea* has also been illustrated. This one has a bit of the old Great Eastern line in her make-up, too ; chimney, dome, safety-valve casing, and cab outlines are distinctly "Liverpool - Street - East - Side - Suburban." I understand that the boiler was made by "Two-Dollar" Summerscales, who sometimes advertises in this journal, and she has a Reeves steam gauge. The pictures show the quality of the workmanship and finish, in a way that needs no addition from written words ; and she goes as well as she looks. Steam is raised from all cold in five minutes by aid of a suction fan of the type used by friend Adams of *Caliban* fame (by the way, Bro. Edward, you promised to let us hear the results of your experiments with that unconventional but highly ingenious box of tricks ; what about it ?) and there is no trouble in maintaining pressure, as friend Burtt managed to get a 100 lb. sack of Welsh nuts from the coal wharf at Charlestown, Mass., so he won't have to worry about fuel shortages for some time to come. Incidentally, the motor for the fan came from a 35-year-old drink mixer which had tossed many thousands of milk shakes in a drug store ; a bit of a change-over from white to black ! The name of the engine commemorates a well-known character in American history, and it is proposed to add a Brotherhood crest or insignia. Congratulations on a worthy representative of a big family.

And Now to South America

Several correspondents who have purchased the new "Live Steam" book, and read the second preface, say that Valparaiso, Chile, would be about the last place on earth in which they would expect to find "L.B.S.C." engines being built. They apparently thought I was doing a bit of leg-pulling ; but they were wrong. Old Curly never makes a statement that cannot be substantiated ; and in that, he is different from folk who make exaggerated claims. People used to think I "drew the long bow" when giving particulars of locomotive performance, but they know better now ! If our first-mentioned friends will take a look at the other pictures reproduced here, they will both see and learn about a *Juliet* type engine built by a resident in the town mentioned.

About two years ago I received an airmail letter from a Mr. Froilan Orrego, of Valparaiso, who informed me that his son Alvaro was building a *Juliet* engine, but was unable to obtain all the necessaries, including silver-solder, for the boiler ; could I put him on the track of what he needed ? That query was soon disposed of—I wish to goodness they were all as easy !—and in due course I received a very nice letter of thanks, with a promise to let me know how the engine progressed. It progressed to such good purpose, that not long afterwards, I received a letter from young Alvaro, saying that he had made a good job of the boiler, and it had stood up to test with no leakage ; he was just going to erect it. The next letter was one that gave me as much pleasure as the builder himself had experienced ; he had the engine in steam, and not having any permanent line at the time, nor a passenger car, he laid a short temporary track. The engine ran all right on this ; so in order to test her hauling power, he rigged up a temporary car by nailing a piece of flat wood on an old roller skate, coupled it up to the engine, and sat on it. He hardly expected her to pull a load like that, but she did ; and he was so delighted that he sent me a present. He said it was some job maintaining his balance on the ragtime car ; I reckon it was, too ! The engine was finally completed, except for a second coat of paint, and a few small items such as handrails, etc., and the result you can see in the picture reproduced here. Kennion Bros. supplied the castings.

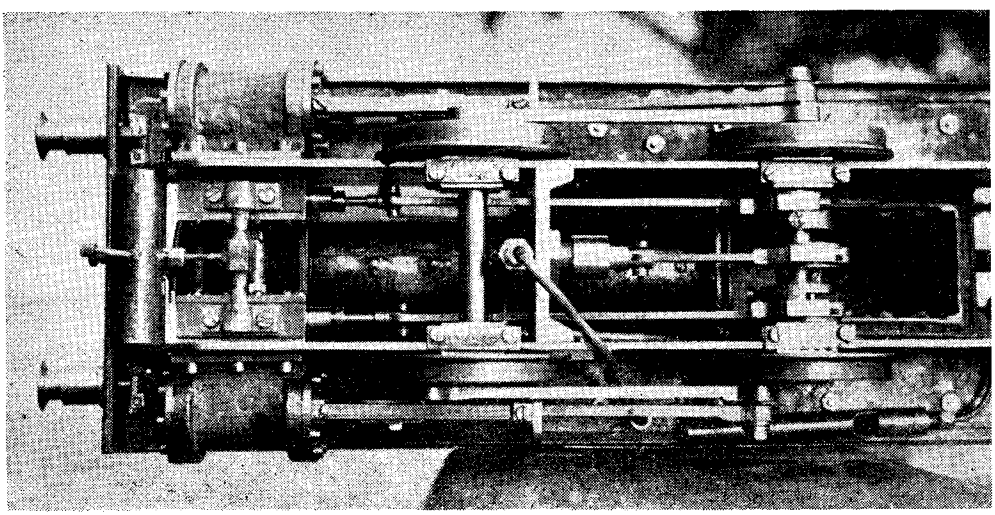
The Chilean *Juliet* works under difficulties, but they don't appear to worry her overmuch. For the start, there isn't any decent steam coal in the country, that is suitable for weeny fireboxes, so friend Alvaro has to feed her on charcoal. However, the particular brand he uses, is of a different kind to ours, lasts much longer, and gives bags of heat. The engine can do 13 laps of the line, at a good speed, on one firing. The line itself is laid on a concrete viaduct about 2 ft.



The Valparaiso "Juliet"

high, and is oval in shape, about 30 ft. long and 15 ft. wide; these 7 ft. 6 in. radius curves put a tidy strain on the engine, by virtue of flange friction coupled with excessive slipping on one side of wheels. The straight sections between curves, ease things out a little. The rails are $\frac{3}{8}$ in. square iron, screwed to 1 in. square wood longitudinals. It took a "permanent way gang" of three, to lay the line, Orrego senior and a friend doing the needful in the way of assistance.

The passenger car is similar to the old simple test car which I described about 18 years or so ago. The bogies are just two hardwood blocks, recessed to take ball bearings. Footboards are provided, and the car will accommodate two persons, which the engine hauls with ease, despite the sharp curves. Alvaro says that the engine starts steadily and easily, without any slipping, and accelerates quickly with a nice even sharp beat. She has given no trouble whatever; pump, lubricator, boiler mountings, etc., all doing their job in first-class style. Our friend says he is astonished at the way the needle of the steam gauge walks around when he puts the blower on; and the engine does everything that I said it would do. Well, hearty congratulations to our young Chilean friend on the success of his extremely creditable first attempt.



"The works" of the above "Juliet"

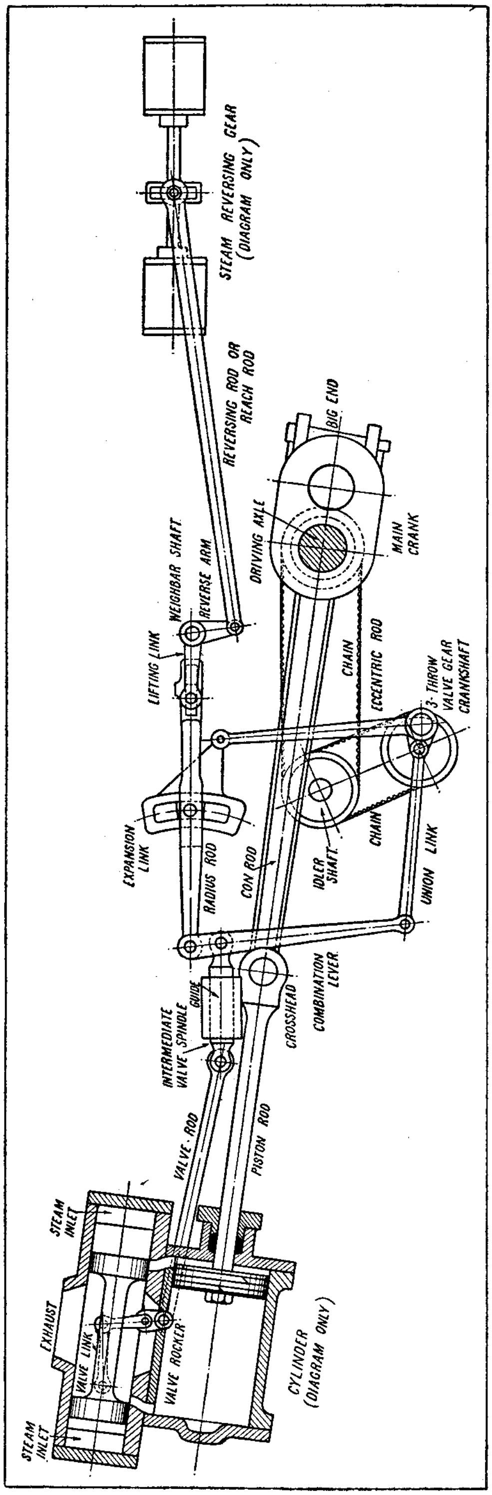
A Challenge Answered

In the paragraphs above, I settled the doubts of one class of "unbelievers"; but there is another class who are, as the kiddies would say, "just sticking their necks out and asking for it," and I propose to deal with them in a way which I hope will amuse the older followers of these notes. The latter often chaff me and say that the Live Steam notes aren't as pugnacious as they were at first; well, the only reason for that is because the "opposition" found out that I was able to prove every contention made, and they promptly "simmered down," to quote the kiddies once more, bless their hearts, who are still trying to find out which way the wire goes from my full-size signal, to the signal-box up on the railway bank!

You all know the super-patriot whose motto is "My country, right or wrong." There are certain folk who say exactly the same about a railway, whether they work on it or not; and everything appertaining to that railway, *must*, of necessity, be right. Incidentally, I only know of two people who ever praised the old L.B. & S.C.R. radial tanks and the "Vulcan" tender engines, and neither of them had ever driven or fired one, which accounts for the milk in the coconut. Well, there are some rabid Southernites who sing the praises of the "spam cans," and they query your humble servant's knowledge of their construction and operation. One particular party went as far to say, in a rather sarcastic letter, that I knew nothing whatever about the arrangement of the valve-gear, and challenged me to publish a drawing of it. There is nothing I like so much as a "scrap," provided it is clean, and my opponent sticks to relevant points and avoids personalities and what is popularly called "mud-slinging"; so I propose to ignore the "sarky" part of the letter, accept the challenge, publish the drawing with a little explanation and comment, and then my opponent can hide his diminished head and forever hold his peace.

The Valve-gear of the "Spam Cans"

Here you see, in semi-diagram form, the layout of what most locomotivemen, with the exception of the "rabid patriots" mentioned above, consider the most unmechanical and inefficient type of valve-gear ever fitted to a Southern locomotive. Of good points it has practically none; of bad points, plenty, as has been found out in actual service. A chain sprocket is mounted on the crank axle, close to the crank web, and the drive is taken from this, by a roller chain, to a similar wheel on a short idler shaft supported by brackets. There is another sprocket on the idler shaft, whence another chain goes to the sprocket on the valve crankshaft, situated on a lower level than the engine's axles. This shaft has three cranks; each one operates both the eccentric-rod connected to the expansion-link, and the union-link connected to the combination lever. The union-link drives the combination lever in the usual way, being coupled to it direct; but the eccentric-rod is vertical, instead of being horizontal as in ordinary Walschaerts gears, and drives the link in bell-crank style via a triangular extension at the back of the link. The expansion-



link is very short, the dieblock movement in full gear being only a little over one-third of the valve travel; see below.

The radius rod is forked, each side of the fork passing between the link and the outer plates; and a big loop is formed in the radius rod just behind the link, to accommodate the end of the eccentric rod and the triangular extension of the link, which operate inside the loop. The lifting and lowering of the rod is done by a die working in a slot in the end of the radius rod beyond the loop, in the usual manner; and the weighbar shaft carries the usual lifting arms and reversing arms. It is actuated by a power reverse gear; this works a separate shaft situated between the steam and cataract cylinders, via a slide crank, the slide being formed in the common piston rod. This shaft carries two vertical arms which are connected to two drop arms on the sections of the weighbar shaft, by two small reach rods or reversing rods.

The combination lever is of the usual pattern; but instead of being connected direct to the valve spindle, it operates a plunger working through a guide, similar to the intermediate valve spindles of the old between-cylinder link motion layouts. The other end of each plunger is coupled by a rod, to the lower arm of an unequal rocking lever; the upper arm of the rocking lever actuates the valve by a link connection as shown. The valves are outside admission, exhausting through the centre.

Unnecessary Complication

If the valve-gear showed any advantages in service, giving a better steam distribution, and requiring less maintenance and general attention than the ordinary type of valve-gear, there would be some justification for fitting such a complicated box of tricks. It literally *is* just that, being totally enclosed in a case. In actual practice, the whole outfit has been nothing but a pack of trouble. It is claimed that operating the gear from a separate shaft, eliminates any inaccuracy of valve events, due to the rise and fall of the crank axle when running; whereas actually, there is more inaccuracy, due to the multiplication of moving parts. No less a person than old Tim Hackworth, tried the wheeze of a separate shaft to operate the valves of his vertical-cylindered engines, and soon discarded it, because the extra joints played Old Harry with the valve setting, as soon as they began to wear.

Then there is the question of wear and stretch of the chains. It has been stated that the chains do not stretch; whether the claim has been put forward, that they don't wear either, is something I don't know about at the moment. All I *do* know, is that many of the "spam cans" have received new chains—there is, or was, a pile of discarded chains at one Southern depot—and if the chains neither stretched nor wore, why were new chains fitted? That is a fair question, surely! On the demonstration trip of *Union Castle*, with a few coaches carrying directors and officials, a chain broke, between Anerley and Penge West, when the engine was going towards London, and made a fine mess of the whole works. The firm who made my gasoline buggy provide the finest chains it is possible to get, for driving the camshaft from the crankshaft of the engine. The stress on this chain is a mere fleabite compared with the stress on a chain driving three sets of locomotive valve-gear (there isn't such a wonderful amount of difference in the size of the chains, either) yet, in their latest type, the motor folk are providing a jockey-pulley to compensate for stretch and wear on the chains; a fact that speaks for itself! Another point is, that a broken chain on a "spam can" stops all valve movement at once, and if the valves cover the ports, the wheels lock. On one occasion, to my knowledge, when this happened, it took three normal engines to get the "spam can" off the train and into a siding; a nice state of affairs, if you like.

To my way of thinking, the most objectionable feature is the final drive to the valve. It would be weak and unmechanical enough if the rockers had equal arms; but the stepping-up of the valve movement in the proportion of nearly three to one, is just asking for trouble. The veriest Billy Muggins can see at a glance, that any wear and inaccuracy in the valve gear itself, is immediately increased or multiplied nearly threefold, in the valve events—that is, even if the rocker gear itself is like Mrs. Caesar, which it usually isn't. Then there is the terrific leverage stress, caused by the unequal arms; this is reflected back through the various joints in the valve-gear. The designer claimed that incorrect valve events, due to wear, could be negatived or counteracted by the driver adjusting the reverse gear. You should hear the drivers themselves on this subject; when they try to notch up, they lose some of the beats altogether. I have already told how one went past here, last Easter, with "three beats and three nothings" per revolution. There are two chain-driven oil pumps in the sump, which are supposed to keep the whole issue flooded with oil when the engine is running; but the amount of oil used is appalling. Where it all goes to, is apparently a mystery. Once, when a Southern driver friend was here, I happened to mention that I was nearly out of oil for my little engines; he grinned and said that I would find plenty in the ballast, on any route where "spam cans" ran.

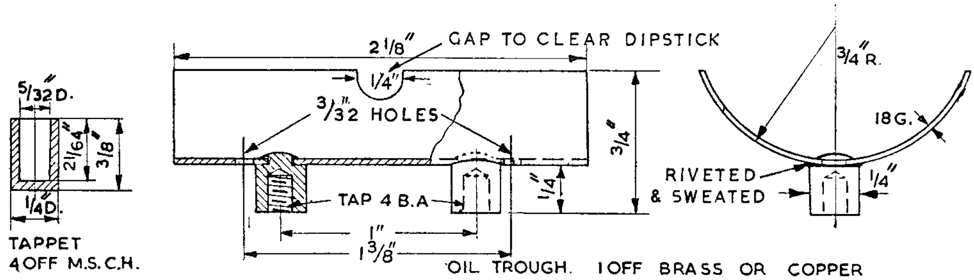
Well, I don't think there is need to dilate further. The above is my answer to the challenge thrown out by the "Doubting-Thomas-super-patriots"; maybe it will prove to them, that my knowledge of "spam can" construction and operation is greater even than their own. I could "spill the beans" on a lot more defects, especially in the boilers, steam pipes, and so on; but "sufficient unto the day is the evil thereof," as the old saw puts it. Anyway, it doesn't need the mantle of Elijah to prophesy that when, in the near future, the engines need heavy repairs, the rebuilding will be drastic; it is quite possible that they will look like *Pamela*. It is also a significant fact that, pending the appearance of the new standard B.R. engines, more of the erst-while G.W., L.N.E. and L.M.S. types are being built—*but no "spam cans"*; and on the Southern Region, the *Nelsons*, *King Arthurs*, *Remembrances*, *Schools*, and what-have-you, have all been fetched out of store and returned to service. Straws show which way the wind blows—nuff sed!

PETROL ENGINE TOPICS

*A 10 c.c. Twin Four-Stroke

by Edgar T. Westbury

THE machining of the tappets is very simple, and they may be made from ¼-in. mild-steel rod to save machining the outside, provided that it is accurate and bright finished. Hold the rod in the three-jaw chuck for facing, centring and and drilling; the object of making the tappets hollow is both to lighten them as much as possible, and also to form a clearance for the end of the valve stem. After parting off, the base surface of the tappet should be machined dead flat, and with a good tool finish. The tappets are finally case-hardened and polished, special attention being again paid to the finish of the base surface.



Oil Trough

It may be thought that this trough serves very little purpose, considering that the ends are open and therefore cannot possibly hold oil. However, its proper function is that of a separator or baffle to isolate the oil in the lower part of the sump from that being churned up by the cranks. In the absence of a baffle, all the oil will be thrown out of the sump and none will remain in a liquid state; this makes oil control difficult, as the cylinder walls are over-oiled, and though the main and camshaft bearings will catch plenty of oil very little will reach the big-end bearings, whi h are most important of all.

With the trough in place, however, the oil will remain fairly quiescent in the sump, and though any oil in the trough will be swept out at each revolution of the crank, the holes under each big-end will allow fresh oil continually to flow in and keep up constant circulation. A certain amount of oil will also flow in at the ends of the trough, to be caught by the crank webs and be splashed over internal parts, including main bearings. The surplus oil runs down the crankcase walls and returns to the sump at the sides of the trough. While this system of lubrication is not so efficient as direct force feed to the bearing surfaces, it is quite effective for engines which are not too highly stressed, and will work with a fair latitude of oil level. It has proved very satisfactory in the case of the "Seal" engine, and no attention to the lubrication is necessary over fairly long periods of running, though it is advisable to test the oil level, and replenish if necessary, for each day's run.

The construction of the trough is simple, and it can be bent over a 1½-in. mandrel, from soft brass or copper sheet, the supporting pillars being turned from brass and shouldered at the ends to about ⅛ in. dia., to enable them to be riveted in, the other ends being faced, drilled and tapped 4 B.A. Before final assembly, the trough should be tried in position, to make certain that it does not foul the crank webs or big-ends; it should not, however, allow excessive clearance below the latter.

It will be noted that a gap must be allowed in the centre of the trough on one side to clear the dipstick; this should give sufficient clearance to avoid risk of scraping the latter when removing it from the sump and thereby showing a misleading oil level. If the shaft line of the engine is to be inclined more than about 10 deg., it will be desirable to fit two cross partitions in the trough, shaped to fit under the flanges of the centre main bearing, so as to prevent one big-end getting all the oil at the expense of the other. It is, however, better to keep the engine fairly level laterally, if this can be done without having to take up excessive angularity in the propeller shaft coupling; the latter, in any case, should be of the fully articulated ("universal") or flexible type.

Breather Components

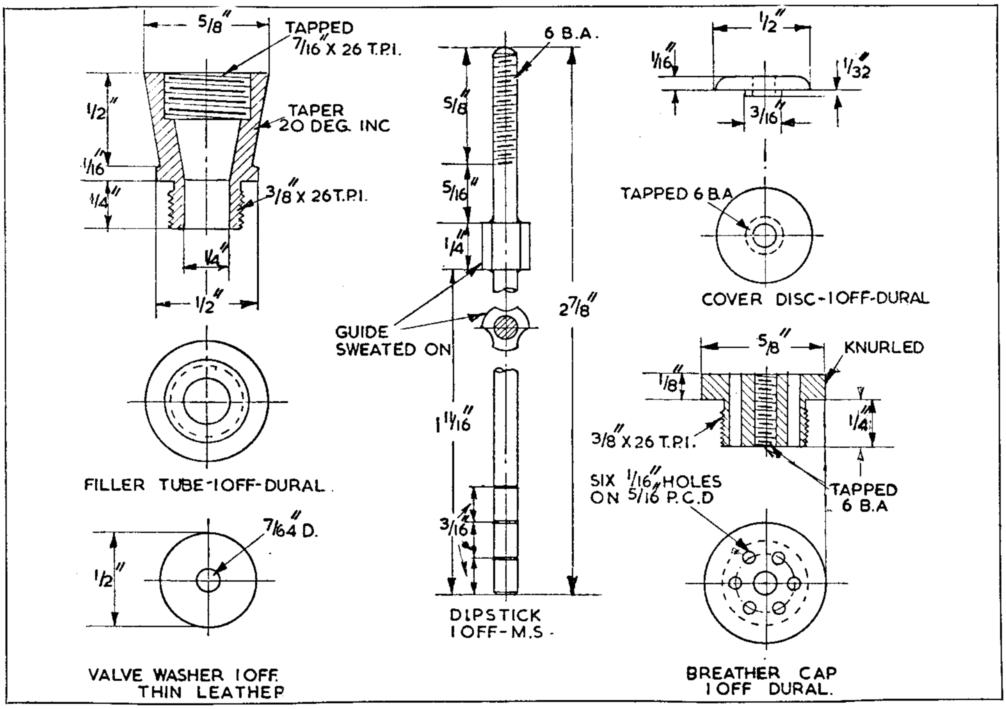
In order to facilitate access for replenishing or topping up the oil supply, the breather cap is not fitted directly to the crankcase, but to a funnel-shaped extension filler pipe. The breather, in this engine, must be something more than a crankcase ventilator, as air is actually displaced by the two pistons working in phase, and the venting

*Continued from page 568, "M.E.," October 12, 1950.

must be adequate to allow for this. In addition, it is desirable that a light non-return valve should be fitted, as in single-cylinder four-stroke engines, to keep the average crankcase pressure slightly below atmospheric, and thereby help to prevent leakage of oil from the outer ends of bearings.

The material recommended for the main breather components is duralumin or other fairly strong aluminium alloy ; brass is quite suitable mechanically, but somewhat out of character for these parts. They may be turned from bar held in the chuck, the largest diameter being $\frac{5}{8}$ in., and this size of rod may be used if it is chucked accurately. The filler tube may be machined large end outwards, being first faced, centred, drilled through $\frac{1}{4}$ in. dia., then counterbored and tapped $\frac{7}{16}$ in. × 26 t.p.i. ; after which, the outside may be machined, setting the top slide to an angle of 10 deg. for the taper (this is not critical), and boring the inside to the same angle. Before parting off, the rear end may be necked down to slightly over finished size.

To chuck the component for turning and screwing the lower end, it is advisable to make a screwed stub, which may be utilised later as the breather cap if desired. The thread should either be screwcut, or cut with a tailstock die holder, to ensure that it is true, and a slight but not excessive undercut with a narrow parting tool is advisable to enable the tube to screw right home to the shoulder. Turn the end of the latter to finished size, and cut the thread in the same manner as before ; in this case the advantage of screwcutting will be appreciated, as it will avoid the problem which often arises when the die, instead of unscrewing from the work in the approved manner as per drill book, insists on holding tight to the latter and unscrewing it from the stub. Should this occur, however, the best way to deal with it is to expand the die at the end of the cut, by tightening the centre adjusting-screw of the holder, before attempting to unscrew it from the work.



Details of breather components

It is advisable to cut the $\frac{3}{8}$ in. thread slightly on the tight side so that it does not tend to unscrew when the breather cap is removed ; but do not make it so tight that there is a risk of twisting it off in assembly. A piece of rod with a $\frac{7}{16}$ in. × 26 t.p.i. thread on the end should be used to screw the tube into the crankcase, a carrier or drill chuck being employed to enable the necessary torque to be applied.

The breather cap, after being machined, screwcut and knurled, is parted off and carefully faced on the top surface. In this case a piece of material held in the chuck, and drilled and tapped to take the screwed cap, is recommended for holding it. A 6-B.A. hole is drilled and tapped through the centre of the cap, and six holes, $\frac{1}{16}$ in. dia., drilled around it on a pitch circle of $\frac{5}{16}$ in. dia. I always carry out operations of this nature with the aid of a drilling spindle on the lathe cross-slide, in conjunction with headstock indexing ; this is much simpler, quicker and more accurate than marking-out and drilling in the usual way, and the trouble of making the necessary fittings will be repaid a hundredfold on the innumerable jobs of this kind which crop

up. The holes may be pitched inwards at a slight angle, if desired, to avoid any possible risk of them running out towards the thread of the cap.

The valve cover disc is faced, centred, drilled and tapped, and spigoted, then before parting off fully, the top edge may be rounded off with a hand tool. With care, it should be possible to part off cleanly so that no further finishing of the top surface is necessary; but failing this, a 6-B.A. steel stud held in the chuck will provide a secure enough mounting for a very fine skim over the top.

A piece of 7/64-in. rod (such as Juneero rod, which is just the right size, and has a matt surface finish very suitable for this purpose) may be used for the dipstick, but if this is not available, use ⅛-in. rod and turn down the end for a length of ⅜ in. to take the 6 B.A. thread. The marking grooves at the lower end should be cut cleanly with a point tool, and sufficiently deeply to be quite distinct. A guide-piece, which serves to centre the rod in the filler tube, is made from brass or steel rod, and sweated or tightly pressed on to the dipstick in the position indicated. The grooves in the guide are to allow the passage of air, and may be filed if no other methods are available; but here is another job where the drilling spindle can be applied, and will save time and trouble.

The valve washer may be made of thin leather, such as a bit of old kid glove; alternatively, proofed fabric such as in petrol pump diaphragms, plastic sheet ("p.v.c.") or synthetic rubber may be used. If no hollow punches or washer cutters are available to make a clean job of the washer, cement the material to a piece of wood with Seccotine or glue, and when set, mount the wood on the faceplate and trepan the washer with a sharp penknife, as the lathe revolves, also use the same method to cut the centre hole. Soak the lot in water to remove the washer. When fitted to the breather cap, the cover disc should be screwed down just tight enough to clamp the washer, not to crush it, and a lock-nut is then used to secure the disc.

The breather may be tested by blowing through it; air should pass quite freely in an upward direction, but it should completely seal off the passage in the reverse direction. In cases where the breather gets completely saturated with oil, the washer may tend to stick to the cover disc and remain open; this should not normally occur, but if it is a persistent condition, a brass foil washer about 0.005 in. thick, with half a dozen nicks in the edge, may be placed over the leather washer to act as a spring and keep it down. As an alternative to the flexible washer, a metal or fibre washer may be used, in which case the cover disc is not screwed right down, but is used as a lift adjustment, and locked, as before, with a nut. Rigid disc valves of this kind are often used, but I have found them liable to be noisy unless the lift is kept very small, when they tend to restrict the air passage.

(*To be continued*)

For the Bookshelf

The Slide Rule in Theory and Practice, by G. P. Rawlings, O.B.E., M.A.(Oxon.). (London: Percival Marshall & Co. Ltd.). 127 pages, size 5 in. by 7 in. Illustrated. Price 9s. 6d. net.

The slide rule is an instrument on which quite abstruse calculations can be made quickly and easily; yet to novices and others who do not understand it, or have never had occasion to make use of it, it is something of a mystery and even an object of suspicion.

This book makes everything clear; it begins with an introductory description of the slide rule, follows on with an explanation of why the slide rule works, how it works by means of certain fundamental operations, and ends with numerous examples of the different applications of those fundamental operations. The final pages are wisely and conveniently devoted to tables of logarithms, antilogarithms, sines, cosines and tangents.

The author's style is now well-known, through his previous successful book, *Trigonometry Made Plain*, and is admirably maintained in this new book; excepting the purely tabulated matter, there is not a dull page, for the reader's interest is firmly held throughout.

Body Engineering, by Sydney F. Page. (Chapman & Hall Ltd., 37, Essex Street, London, W.C.2.) £1 4s. net.

Here at last is a book that will fill what has been a regrettable gap in the literature relating to this all-important subject.

More important even than its relation to the lasting qualities of the motor vehicle, good body engineering carries an important function in export sales, and *Body Engineering* will enable both designers and draughtsmen to attain a high standard of efficiency.

The book is divided into eight sections, starting with an introduction dealing with historical background and carrying on through materials, designing and drafting. The book also contains sections on sheet metal projection, trailers and caravans, bodywork, interior and practical bodywork construction, ending with an interesting and useful constructional supplement.

A must for all connected with this particular branch of the motor industry, and a very commendable work for those model engineers striving to produce correct scale model motor cars.

A MODEL BUS

AS an example of what can be achieved with a minimum of tools and expense, the model of "Coventry Transport No. 234" bus built by Mr. R. Stokes, may prove to be worth a close inspection. The model is 26 in. long, 15 in. high and $7\frac{1}{2}$ in. wide, and only the tyres and wood-screws (numbering three gross) were bought. Tools for the job, apart from hand tools were home-made drilling machine, lathe and circular saw. Nearly three years of spare time were needed to complete the work, which Mr. Stokes describes below.

Drawings

All the measurements were taken with a foot-rule from the full-sized bus, and rough sketches were made in turn of each section to be built. A scale of 1 in. to 1 ft. was used.

Chassis and Springs

Two strips of sheet metal joined by cross-members, make up the chassis. The sheet metal was cut out and flanged, and cross-members, dumb-irons, etc., were riveted in position. Typical of the close attention to detail are the springs, each made with the proper number of leaves from a band-saw blade minus the teeth. Shackles and links completed the assembly.

Axles and Wheels

For the back axle, $\frac{5}{16}$-in. mild-steel rod was drilled for half shafts and differential ring was added.

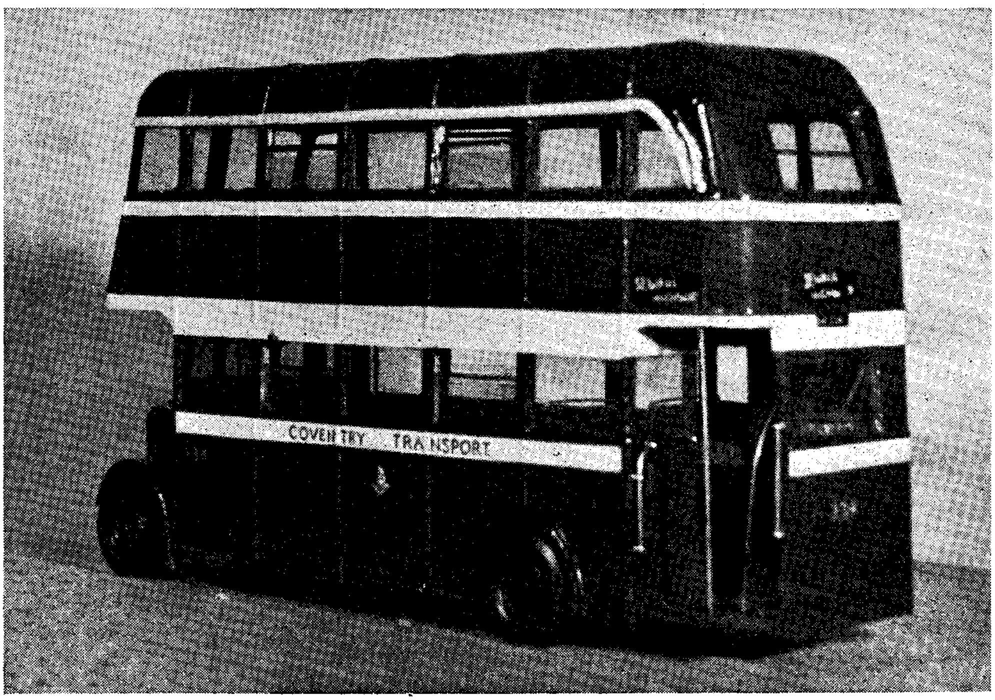
Five-sixteenth inch mild-steel, hammered and filed to shape, was also used for the front axle. Swivel-pin eyes were drilled to give the correct angle for castor-action. Stub axles and wheels, complete with step rings made the detail complete. The tyre rims and wheel centres were turned in one piece, the tyres, which were Dunlop 9.00-13 being sprung on.

Steering

The steering ratio of the full-sized bus, employing worm and quadrant, in a box made from white metal, was a feature of the steering. Ball joints for the track-rod and drag-links were filed to shape and riveted in place. Both the steering mechanism and other controls can be worked from the cab, return action being provided by springs attached to the chassis.

Cab Radiator and Bonnet

Gear selector, footbrakes and hand-brake all "work," and are to be found in their appointed places. The bonnet was made in one piece, a



hinge riveted in place, the bonnet itself being scribed through afterwards, thereby ensuring a perfect joint with the bonnet closed. Spring clips are fitted to the bonnet sides. The radiator, of mild-steel, was filed to shape in sections and soldered together.

Body

Full-sized practice was again faithfully imitated, and the body, pillars and frame were built up of $\frac{1}{4}$-in. square ash, jointed and screwed together. The floors, of plywood, were made in one piece. Panelling was provided by old food tins, cut to shape and screwed to the frame. For the front and back roof-domes the same tin was used. After " basting " the metal as far as possible into shape, cutting and soldering, the final touches were applied by beating again.

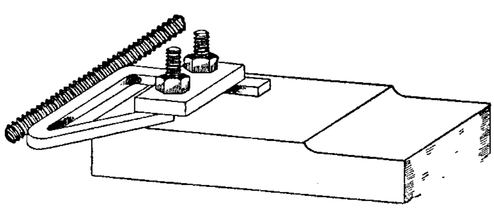
Before fitting glass to the window-frames, the roof and lower saloon head linings were screwed into place. Seats, made of wood with tin sides, upholstered with cloth and complete with wire hand-rails across the back, were inserted through the window-frames and fitted in place. Nothing was omitted which might enhance the true-to-life appearance of the interior. Even dummy electric lights were fitted.

After painting the interior, the window glass (old picture glass) was added. Four windows on each side can be opened on slides. A " neat " driving mirror cut from a looking-glass and measuring $\frac{5}{16}$ in. $\times$ $\frac{1}{2}$ in. completed the model.

SUPPORT FOR SCREW CHASING

DUE attention should always be given to the choice of a support rest for the chaser when undertaking the work of chasing screw threads. The common form of support is shaped like the letter L, but unless good thick material is used in its construction, the chaser tends to pull in, which is very noticeable on steel jobs.

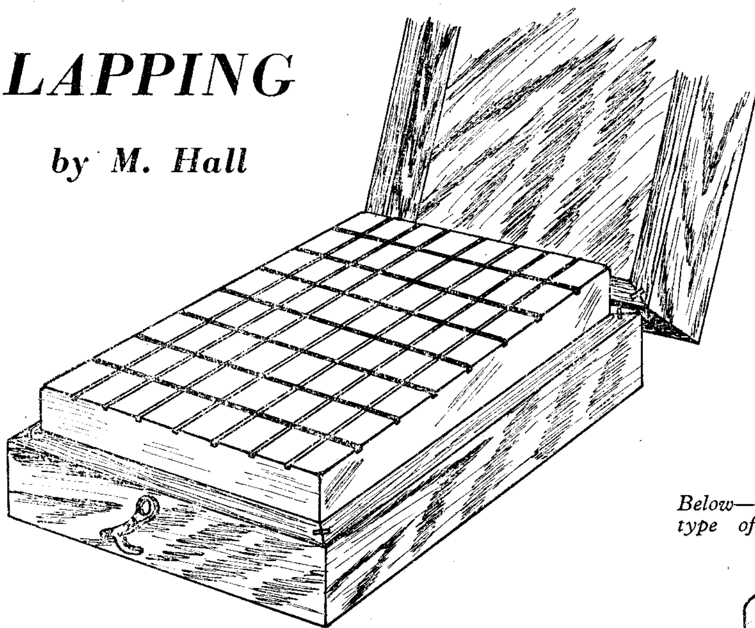
In place of the above-mentioned support, try the following idea, which will be found a much more rigid method in every respect. The improved support is clearly indicated in the accompanying illustration and, the L is continued round a bend, the end of which is held in the tool-holder, thus giving full support to the chasing edge near the work. It is quite a simple matter to forge a support of this kind and is well worth while. The same support, of course, may be used for scraping operations as well as for screw thread chasing.



—W. J. SAUNDERS.

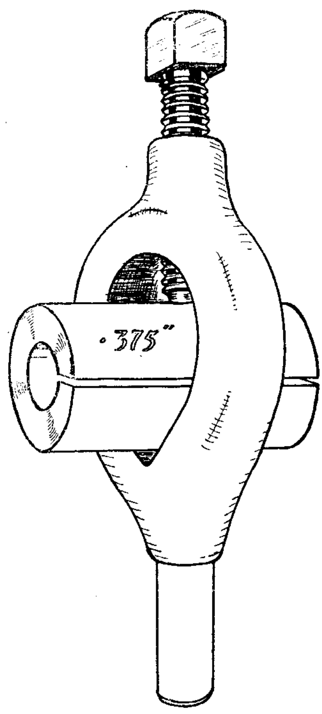
LAPPING

by M. Hall



Left—Fig. 1. A protected lapping plate

Below—Fig. 2. A simple type of circular lap



BASICALLY, lapping consists of applying a suitable abrasive-impregnated tool to the work in such a manner as to cut a true and uniform surface.

Laps can be made of such materials as lead, copper, soft brass and cast-iron, and are usually lubricated by paraffin oil, extra light machine oil or soda water. Commonly used compounds are emery flour and jewellers' rouge.

The type of lap to be used largely depends on the condition of the surface of the work. If a rough ground finish is left, then the normal procedure is to start with a lap of soft material such as copper ; this is fast cutting and quickly removes the ridges and high spots. For finishing, the lap should be of cast-iron, and with the use of a fine compound correctly applied, a very high finish can be attained.

Lapping Flat Surfaces

For small work such as that with which the average model engineer is concerned, a lapping plate of 6 in. by 8 in. should be ample. This is made as shown in Fig. 1. One side is planed or surface-ground, and has grooves cut into it which run at 90 deg. to each other. These grooves accelerate the cutting and allow more pressure to be applied to the work. The opposite side is for fine finishing and is scraped flat with a scraper finely sharpened on an oil stone.

Loading the Plate

The lapping plate is loaded by covering a brass or copper rod with a mixture of light oil and the selected emery flour, and rolling this carefully over the lapping surface. If a cloth damped with paraffin is gently rubbed over the plate, bright spots will probably show up ; if so, the loading process should be repeated until the plate is of a uniform grey colour. A light smear of oil is next applied to the plate and the work is rubbed lightly and slowly, and with a circular motion. The pressure and speed can be increased if no sticking or skidding is felt. After a time, more lubricant will be required, and

it will be readily apparent when the compound ceases to cut, as bright spots will appear on the plate. Before reloading, wipe off the old compound with a paraffin cloth, as it is false economy to apply fresh compound on top of old. The usual reminder should come here—be careful where you put the cleaning cloth, as emery can be an enemy if it gets into the wrong places.

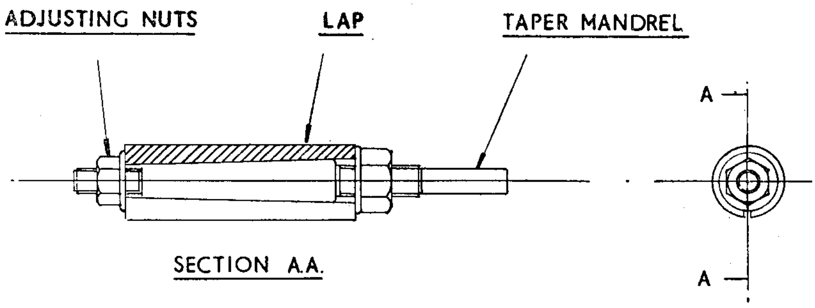


Fig. 3. An adjustable lap

The lapping plate produces high precision work, and with care its life will be long. So when not in use, it should be cleaned and protected from damage.

Circular Lapping

This is usually done on a lathe or drilling machine. For external work, there is on the market a very good adjustable lap, but for those who prefer to make their own tools a simple lap can be made by drilling and boring a suitable piece of material and slitting as shown in the sketch Fig. 2. This lap is held in a lathe driving dog, a dimple being provided to suit the screw, which is used for adjustment.

Internal Laps

Internal laps can be made to a variety of designs, the simplest type being a length of turned bar with a slit in one end to cause the two halves to spring outwards. This type of lap needs some degree of skill in use and is not recommended for amateurs. A better type, but one which takes longer to make, is shown in Fig. 3, adjustment being effected by sliding the cylinder lap up or down the taper mandrel.

Wear on the lap depends on the material and the way the abrasive is distributed. Obviously a soft lap will wear down quicker than a hard one, although even wear on the lap will have no ill effects on the work.

I would suggest in conclusion, that before using a new lap, the size be stamped on it in a suitable position, and that safe storage can be arranged simply by making a wooden stand similar to that shown in Fig. 4.

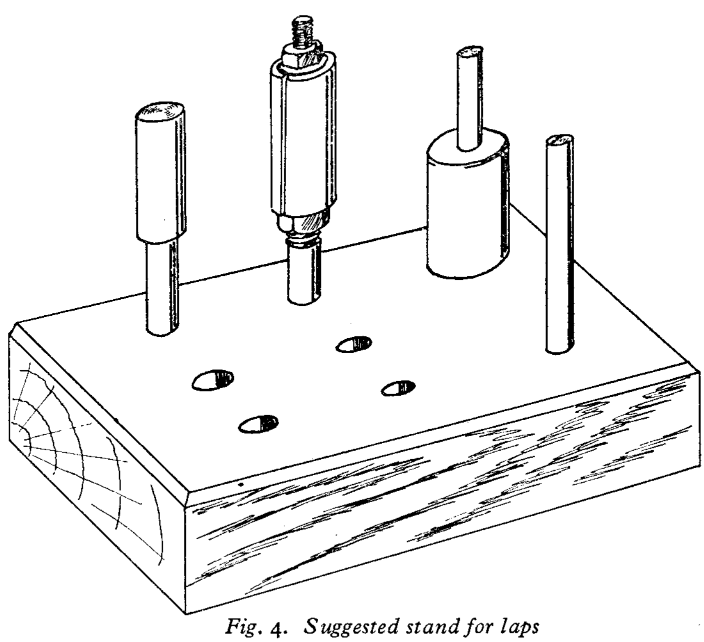


Fig. 4. Suggested stand for laps

Novices' Corner

Springs

SQUARING the ends of compression springs after they have been either cut or wound to length is a workshop operation that has often to be performed.

It is essential that the ends of the springs should be square with the axis for, quite apart from the unsightly appearance presented by the ends being out of square, a spring which has not been corrected may seriously interfere with the working of a delicate mechanism.

It is not possible to bend the ends square, for the work of drawing the temper of the spring locally to enable bending or setting to be carried out is not practicable. However, there is a method whereby both the drawing of the temper and the squaring of the spring ends can be accomplished simultaneously. After the spring has been cut to length, it is mounted on the shank of a drill of suitable size so that each end of the spring in turn may be presented to the side face of a fine-grit grinding wheel. The drill itself is clamped in a V-block to enable the spring ends to make contact with the wheel face squarely, and the spring is allowed to overhang the end of the drill shank by the length of one coil. As soon as the spring comes into contact with the grinding wheel, the overhanging end heats up rapidly and becomes red-hot. This draws the temper of the spring locally and the application of further pressure towards the wheel will then cause the overhanging coil of the spring to collapse upon the coil next to it forming a ground face which is square with the spring's axis.

The condition of the spring before and after treatment is shown diagrammatically in Fig. 1A

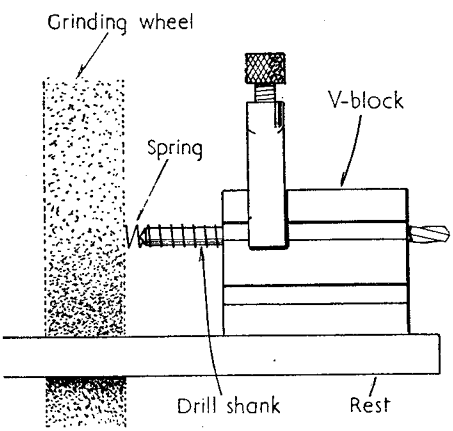


Fig. 2. The arrangement for grinding the end of the spring

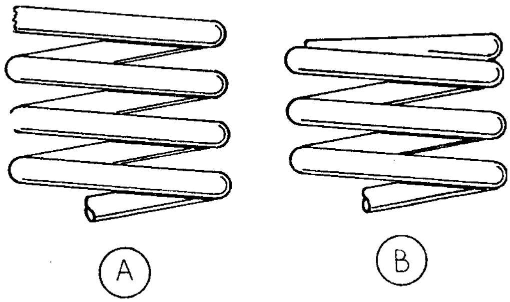


Fig. 1

and 1B, and in Fig. 2 the arrangement of the spring mounted on the shank of a drill clamped in a V-block is illustrated. It will be seen that the V-block serves as a stop for the spring and that the end of the drill shank prevents the spring being pushed too far. The spring must be a good fit on the drill shank, and should be presented to the grinding wheel with the tail of the overhanging coil trailing.

Before mounting the spring it will be necessary to set the drill in the V-block so that the distance measured from the face of the block to the tip of the shank is the same as that of the finished spring. This will ensure that, when the opposite end has been ground square, the finished spring will be of correct length.

Flat Springs

Pieces of flat spring, such as clock or gramophone spring, are often fitted to mechanical parts made in the workshop, and it may be found difficult to form a hole in the material for the purpose of fixing the spring in place. If the end of the spring is softened by heating, so that it can readily be drilled, the softening may extend some way along the spring and so render it unfit for use.

The steel from which springs are made varies in composition and it may be found that a piece of spring becomes hard and brittle after it has been heated to redness and allowed to cool in air. On all counts, therefore, it is better to form the hole in the spring without previous heating.

In commercial practice, holes are made in springs by a punching process either before or after hardening and tempering. Where many holes have to be formed, it will save time and trouble if a small punching jig is made specially for the purpose. An occasion such as this arose when making up the brake bands of THE MODEL ENGINEER road roller ; these bands, made from clock spring, had to have a number of $\frac{1}{16}$ in. dia. holes formed in them to take the rivets used to attach the brake linings. The punching jig made for doing this is illustrated in Figs. 3 and 4, and it will be seen that the body of the appliance carries a sliding punch which is accurately aligned with a corresponding hole formed in the block. As shown, the tip of the hardened punch is slightly relieved so that only its extreme end fits the hole in the block, and so does not tend to become jammed.

Making the Punching Jig

To make the jig illustrated, a piece of $\frac{3}{4}$-in. mild-steel to form the body is taken and a saw-cut, equal in depth to the width of the spring, is first made at a distance of $\frac{3}{4}$ in. from the base of the block. Next, on the end of the work a line

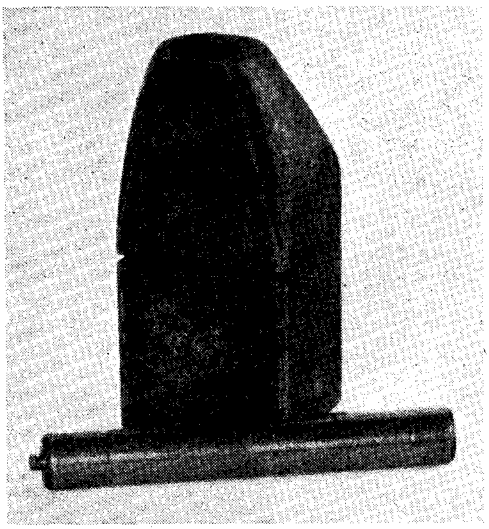


Fig. 3. The punching jig

is scribed at a distance of $\frac{3}{16}$ in. from the face in which the saw-cut has been made. At right-angles to this line a second line is scribed $\frac{3}{8}$ in. from one face of the body. The intersection of these two lines is the centre for the hole to receive the $\frac{1}{4}$-in. dia. punch.

The block is now mounted in the four-jaw chuck, and the centre for the punch is set to run true by means of the centre finder which has previously been described in these pages. The work is then centre-drilled, drilled and finally bored to $\frac{1}{4}$ in. dia. in order to accommodate the punch. A centre-drill is now mounted in the tailstock chuck and run into the work for a distance which will just suffice to start a $\frac{1}{16}$-in. drill. It is important that the edge of this hole should be sharp, otherwise it will be impossible to punch the spring cleanly.

The drill must be fed into the work for some $\frac{3}{16}$ in., after which the body is removed from the chuck and a pair of centre-lines scribed on the underside to permit a hole $\frac{1}{8}$ in. dia. to meet the $\frac{1}{16}$-in. hole which has already been formed. The $\frac{1}{8}$-in. hole should extend to approximately $\frac{1}{16}$ in. from the face of the saw-cut seen in the illustration. The purpose of enlarging the hole is, of course, to allow the punchings to drop clear.

With the drilling of this hole, machine work on the body is completed and all that remains is to file the block to shape. After this the body is case-hardened, using "Antol" or one of the other proprietary brands of hardening composition. Full instructions for hardening small parts such as this were given by "Duplex" in an article on the Kennedy bending machine, published in THE MODEL ENGINEER on August 10th of this year. This article should be consulted for further information on the subject of case-hardening.

The next step is the making of the punch itself. This part is made from a short length of silver-steel. It must again be emphasised that the working portion of the punch is not made parallel, but tapers slightly towards the body. This tapering is best formed by grinding a parting-tool to a slight angle and feeding it into the work until the punch will just enter the $\frac{1}{16}$-in. hole in the block. Care must be taken to preserve a sharp corner on the face of the punch as this materially assists the shearing of the metal during the punching operation.

The hardening and tempering of the punch is, perhaps, one of the more critical operations, for the working end must be sufficiently hard to avoid belling out after repeated operations; yet it must not be so hard that the end will break at the first impact. Accordingly, the end of the punch is first heated to red-heat and is then plunged into cold water in order to harden it. The body of the punch is then polished with emery-cloth so that the changes of colour which

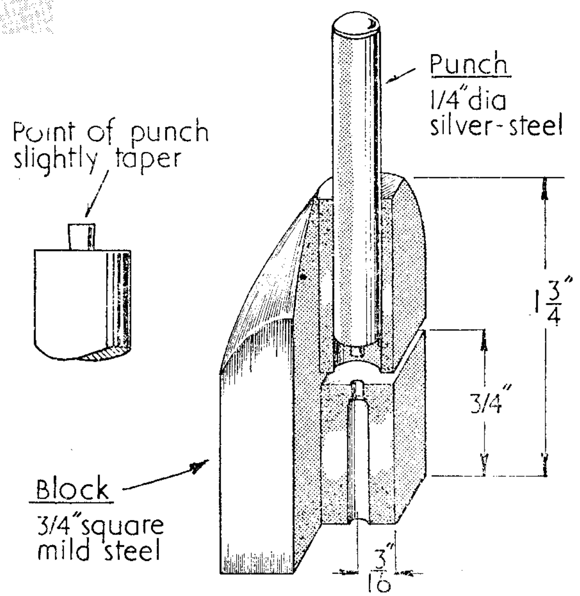


Fig. 4. Details of the punching jig

take place in the tempering process can be clearly seen. Heat is now applied to the shank, by means of a bunsen burner or a laboratory spirit lamp, and as the temperature of the punch rises, the shank will be seen to change colour. As soon as a light straw colour is seen to have crept up the punch and reached a point immediately below the working portion, the punch is again plunged into cold water, and will then be ready for use.

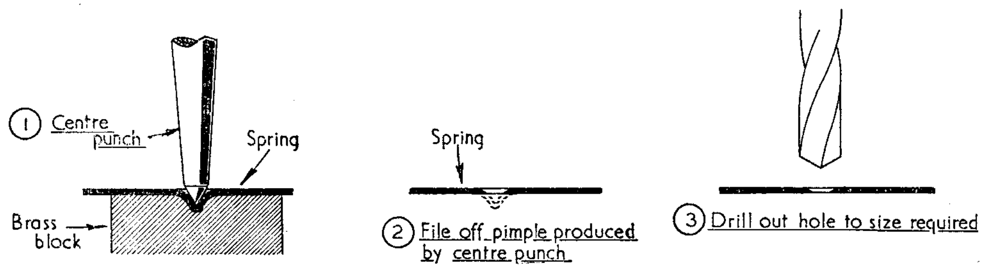


Fig. 5. The three stages in drilling a flat spring

Using the Punching Jig

To use the punching jig, the spring is entered in the throat of the appliance and the upper end of the punch is either struck a firm blow with a hammer, or, preferably, the device is mounted between the jaws of a bench vice so that the punch can be squeezed through the work. If the jig has been properly made, a clean hole will be formed in the spring exactly on its centre-line.

Needless to say, any particular punch will form only one size of hole, and it usually happens, therefore, that for forming single holes of various sizes, drilling is the method adopted.

Drilling Springs

Springs can be drilled quite easily if dealt with in the following manner. The end of the spring is supported on a piece of brass and centre-punched : now, turn the spring over and it will be seen that, as shown in Fig. 5, the metal has been raised to form a small conical pimple. File the top of this pimple nearly flat with the surrounding surface and then hold the spring up to the light : if there is a hole through the spring, well and good ; if not, repeat the punching and filing until a hole is formed.

To enlarge this hole to the required size, finish the operation in the drilling-machine. An ordinary twist drill will cut quite well, as the flat cutting edge at the extreme tip does not now come into contact with the work and the conical cutting-lips are able to cut freely. Run the drilling-machine at a moderate speed and feed the drill firmly, for, if the drill is allowed to rub in the hard material without cutting, the point will become blunted. Where there is difficulty in drilling the spring, a high-speed steel drill will usually be found to cut much better than one made from ordinary carbon steel.

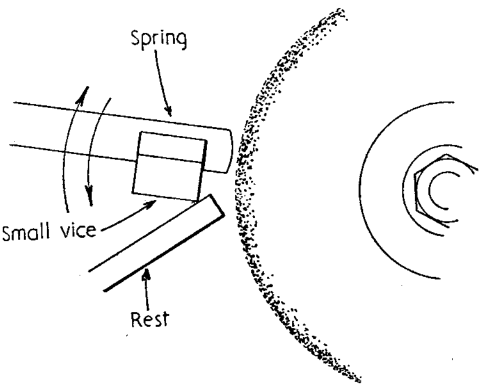


Fig. 6. Grinding the end of a flat spring

The grinding wheel can be used for finishing the work by forming a curvature on the end of the spring. This is best done by gripping the spring near its end in a small machine vice or clamp and then applying it to the periphery of the wheel, as shown in Fig. 6 : if the vice is now rocked up and down, an even curve can readily be formed on the work.

Model Rivets

From K. R. Whiston, 8, Watford Bridge Road, New Mills, near Stockport, we have received some samples of very small rivets which we think should fill a need which has long been felt by many of our readers, especially builders of small locomotives. The rivets are of the snap-head kind, and the smallest are 1/32 in. diameter by $\frac{3}{16}$ in. long ; they are available in copper, steel or brass. We find that their appearance is excellent on such items as locomotive smoke-boxes, tenders and the like, and is much more pleasing and realistic than that which usually results from the use of oversize rivets.

An Interesting Model Steam Plant

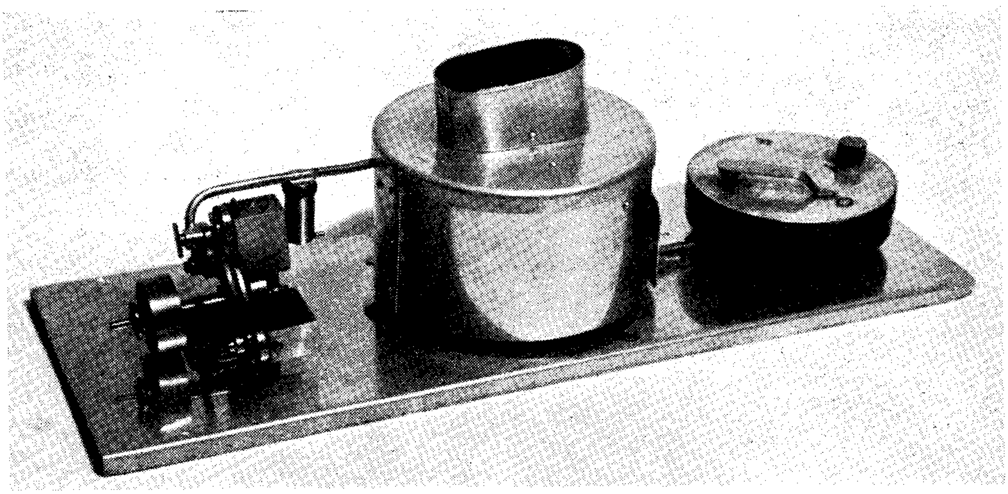
WE have recently carried out some running tests on a marine steam plant which has some novel features. The plant is illustrated in the first photograph, while the second photograph shows some of the features about to be mentioned. The drum-type boiler, which is 3 in. diameter and $1\frac{1}{4}$ in. deep, contains seven vertical $\frac{3}{8}$ in. diameter fire-tubes. The end plates are flanged and the whole boiler assembly is silver-soldered. It is housed within an asbestos-lined aluminium casing and is heated by a vaporising type of burner, using methylated spirit. The boiler casing is closed at the top by a removable cover which incorporates the funnel. This cover is also asbestos-lined and assists the steaming qualities by deflecting the hot gases on to the top of the boiler, and on the steam pipe, which makes a complete turn round the inside of the casing before being connected to the cylinder.

The vaporising burner is fed from a flat circular tank, the flow of spirit being controlled by a regulating-valve with three positions—on, half, full.

The burner behaved very well during the tests in the workshop, especially when in position under the boiler, but no outdoor tests were made. The common trouble of airlocks arose when filling the spirit tank, which could be obviated by fitting a larger filling orifice or a separate vent.

The novelty of the engine lies in the fact that it may be purchased in its most simple form, i.e. single-cylinder, and if desired may later be converted to twin- or triple-cylinder form by the purchase of additional machined parts and pre-fabricated steam pipe couplings, which utilise banjo-type connections. The makers supply an illustrated instruction leaflet for the conversion, which can be carried out by the use of one tool—a small screwdriver.

The cylinders are $\frac{3}{8}$ in. bore by $\frac{3}{8}$ in. stroke single-acting, and aluminium alloy pistons are used. The cylinders are attached radially by screws to a plate which has alternative holes for different cylinder arrangements. Multiplicity of eccentrics is avoided on the twin- and triple-cylinder layout by incorporating in the original design a simple and effective method of operating the piston valves. The crank disc is made of sufficient diameter and thickness to allow an eccentric groove to be machined on its rear face. A projecting pin on the lower end of the piston valve-rod engages with this eccentric groove and imparts the required motion to the valve. The valve operation for the extra cylinders is obtained from this same groove, requiring no extra eccentrics.

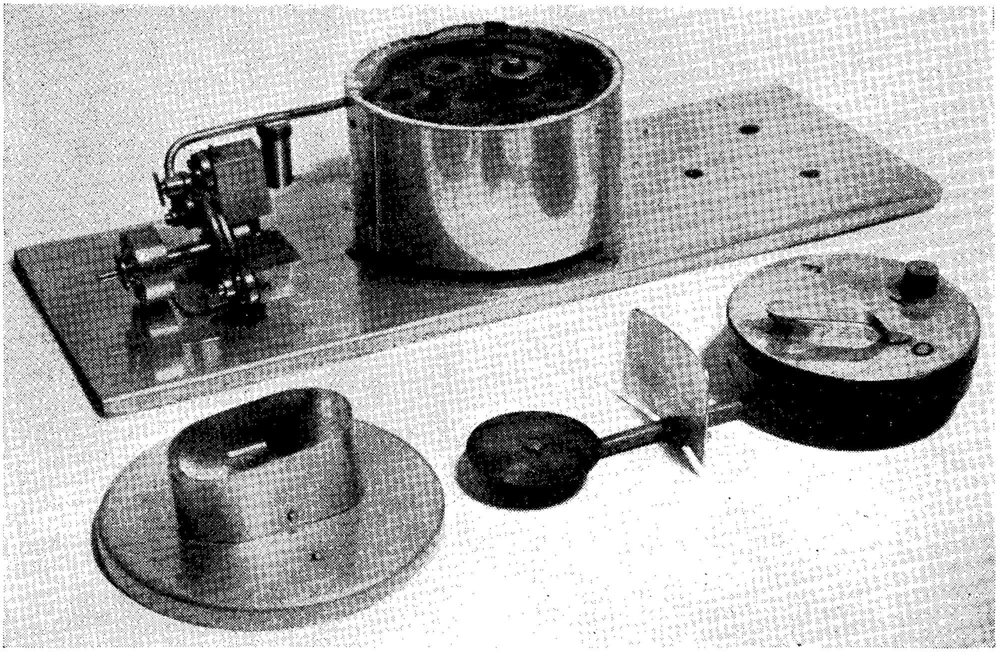


The triple-cylinder form of Hardy Bros.' steam plant

A simple form of displacement lubricator is fitted in the steam delivery pipe to the engine.

The photographs are of the model under review, and being the three-cylinder version, it took all that the boiler supplied. The power was good for the type of plant, especially after stalling to obtain a good head of steam. The three cylinders then made short work of any reserve of pressure, until a steady speed was reached, which matched the boiler output. The boiler primed badly when first starting, and it is felt that some form of dome would assist in a drier " take-off."

Since steam engines of this type are always messy, it would be an advantage to fit a low



Plant with burner and boiler casing top removed, showing fire-tubes

dividing wall between the engine and the burner, since it was found that condensate ran back along the baseplate and sometimes cooled off the vaporising burner.

The engine ran for twenty minutes on one filling of the lamp and boiler, and apart from the lamp being quenched by exhaust condensate, no running troubles were encountered. The plant is suitable for light boats of shallow draught. Further information can be obtained from the makers, Messrs. Hardy Bros., 32, Westbourne Place, Hove, Sussex.

A Model House of Commons

There may be some readers who would opine that the heading to this paragraph envisages an impossibility! But we did not mean it in that sense; what we have in mind is the interesting series of experiments which were undertaken by the National Physical Laboratory to determine the best form of ventilation for the new Debating Chamber at the House of Commons which has been built to replace the one destroyed by enemy action.

The proper ventilation of the House has been something of a major problem for about forty years, and has engaged the attention of a special committee during the whole of that time. Results, however, do not appear to have given absolute satisfaction; so the opportunity presented by the building of the new House has been utilised to carry out a series of important experiments with a view to solving the problem once and for all.

Two models of the building were constructed, one quarter-size, the other full-size, and they have been used to determine the arrangement of a ventilation system which will give an adequate supply of air without causing unpleasant draughts and, at the same time, preventing a dangerous rise of temperature.

The smaller model was built and experiments made on it at the National Physical Laboratory, but the full-size one presented a problem of its own, because of the space required. This was eventually solved by building the model inside the Exhibition Hall at Earl's Court. An interesting point, which is mentioned in a comprehensive account of the experiments, recently published in our contemporary, *Engineering*, is that tests carried out on both models, in similar conditions, indicated that there was no appreciable effect involved due to the difference in linear scale between the two models, and confirmed that the quarter-scale model adequately represented conditions obtaining in a full-scale test, as far as air velocities and air-flow pattern were concerned.

Here we have a particularly interesting instance of the use of models as a means of conducting important experiments from which, we understand, some very successful and useful results were obtained. The information acquired has been applied, of course, to the new ventilation system, and doubtless it will have some influence upon the design and arrangement of other major installations of this kind.

Queries and Replies

Enquiries from readers, either on technical matters directly connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed "Queries Dept.," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of a specialist, or outside consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query, but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

No. 9861.—Hobbing in the Lathe
A.G.M. (Allerthorpe)

Q.—How does one hob in a lathe? I imagine that the hob is made in a similar fashion to making a tap, it is then placed in the chuck, or better still in a collet, supported by the tailstock centre. The gear flank is then mounted on the boring table at centre height on a spigot. The lathe is then started in slow back gear, and the flank fed into the job. Is this correct, and will the hob then turn the flank?

R.—We confirm that the method of hobbing gears in a lathe is carried out in the method you suggest. In some cases, it is found possible to hob small worm wheels simply by mounting them to run freely on a vertical mandrel bolted to the crossslide of the lathe at the correct centre height, but this is a rather uncertain method, and it is generally considered desirable to gash the teeth into about three-quarters of their depth by using a milling cutter, and dividing gear, before applying the hob. An alternative method is to gear the rotating mandrel on which the blank is carried at a suitable speed to generate the correct number of teeth in the wheel.

No. 9875.—Welding Transformer
R.J.R. (Derby)

Q.—I have a cinema arc transformer and wish to redesign same for a.c. welding. It will be for occasional use only, and not for long and continuous work. As I wish the finished product to be of fairly attractive appearance, I propose having a core of approximately square section ($3\frac{1}{2}$ in. $\times$ $3\frac{1}{2}$ in.) and reducing the weight by cutting away some of the upper portion of iron. Would this have any serious effect on the performance of the transformer? The laminations are of standard (0.014 in.) thickness. I intend winding the primary, if suitable, with four strands of 16-gauge wire, each wire carrying 5 amps. Would you state the most suitable output voltage for a.c. work and maximum current available from a transformer of this size? Lastly, could two strands of the original wire be used for the secondary (dia. 0.33 in.), current carrying capacity 65 amps.?

R.—The calculations for large transformers differ from the smaller sizes in a number of respects. In your case you are calling for a transformer working at a different rating to one for continuous use. From the data you furnish, it appears that you have a core area of just on 12 sq. in. This is suitable for an output of 3-4 kW. For welding, a suitable voltage would be 80-90. In this case the turns per volt would work out at 0.89, so you will require 213 turns for the primary. The secondary turns will be 80. A suitable wire for the primary will be 0.080 plain enamel covered copper wire. For the secondary 0-192 is suitable. It is unnecessary to insulate each layer with paper as you suggest, but to assist cooling, the transformer would be better arranged for oil cooling. There is no objection to your altering the transformer as you suggest, provided you do not unduly reduce the winding space.

No. 9857.—Hardening Steels
N.W. (Grimsby)

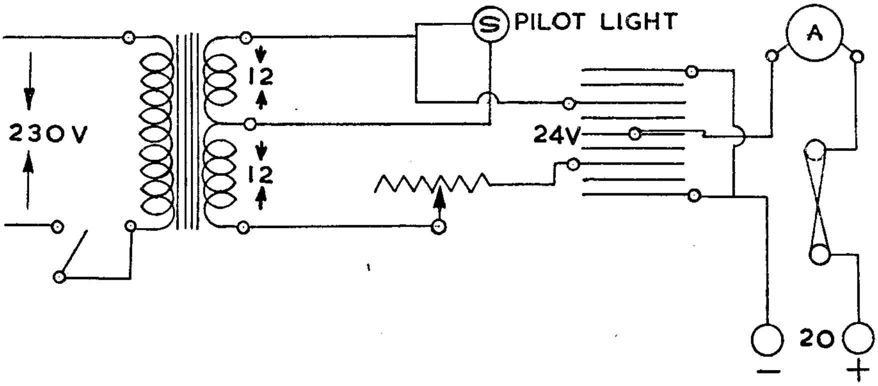
Q.—I am making the battery-driven electric clock, described in THE MODEL ENGINEER by C. R. Jones, and would be very pleased to know how to harden the small trigger block, and trigger.

R.—The components referred to are made of carbon or silver-steel, and can be hardened by heating to a cherry red and dipping out in water or oil. The former will produce the greatest hardness, but some kinds of steel are liable to become brittle, or to crack, in the process of hardening, and oil is generally the safer medium to use for quenching out. The thicker the oil, the slower will be the cooling process, and the hardness will be therefore reduced. Some components are best hardened right out in water and then polished and reheated until the colour of the steel begins to change, which is known as tempering, and the greater the change in the colour, the lower the final hardness. In the event of components being made of mild-steel, they cannot be hardened directly in this way, but they can be given a surface hardness by heating and either dipping in or sprinkling on a suitable case-hardening compound, such as Casenit, then reheating, repeating the process two or three

times and eventually quenching out in water. This will give a glass hard surface to the steel, but the inner core of the steel will still be left soft. It is very suitable for components which have to stand surface wear, but in which brittleness must be avoided.

No. 9871.—Battery Charger Circuit
P.F. (Walsall)

Q.—I have constructed a battery charger circuit from Government surplus equipment, and want to charge a 6-12 volt battery, single if possible. The trouble is overheating of rheostat and transformer winding, due, I think, to over-voltage which, on the charging terminals is 20 volts, irrespective of rheostat control. I do not know the value of the resistance, but it controls the amperage of the circuit very well, except for getting excessively hot, which is to be expected to a small degree. I have tried feeding the rectifier with a lower voltage, but get no output of any use. The transformer rating is 4 amp. at 24 volt centre-tapped, and the rectifier is 5 amp. at 24 volt. Is there any method of decreasing the voltage without absorbing the amperage, as I wish to charge at the highest possible current? The sketch shows circuit as at present.



R.—From your statements, the heating of transformer and rheostat appears to be due to overloading; this refers especially to the transformer. When on full load, both the transformer and resistance will carry a temperature in keeping with the design. So far as the transformer is concerned, a temperature as high as 200 deg. F. would not be excessive. If the transformer is not showing signs of any smoking and it stands the high temperature for any length of time, matters are in order. The resistance may also be designed to have a high temperature. With a rectifier it is usual to have a ballast resistance in series with the regulating part so that the rectifier cannot be short-circuited by cutting out all the resistance. A fixed amount is always left in circuit when you are drawing your greatest load from the rectifier. If the rating of the transformer is 4 amps., it would not be possible to expect 6 amps. for prolonged periods. To give the full output a rectifier must be fed at a certain voltage, any reduction of the input voltage reducing the output. The necessary reduction is obtained by a ballast or the regulator. It is noted that a pilot lamp is fixed across one half of the secondary, and if the current of this lamp is high, it will affect the transformer's output. In any case, it would not be connected as shown, but should be across the full output of the transformer, either at full volts or through a suitable resistance. If things are normal, as outlined above, the resistance of the regulator is incorrect by the fact that the wire size is too small to carry a current of 4 amps., at a normal working temperature. A wire of not less than 16 s.w.g. should be used. Of course, heat on the transformer can be caused by a faulty winding, but in this case it would heat up in a very short time and begin to smoke. As you do not mention any of these effects, your trouble is probably due to general overloading of the transformer, and as you state you wish to charge at a rate of 6 amps. you have probably tried this with the heating result.

No. 9873.—Transformer and Rectifier
A.E.L. (Bexleyheath)

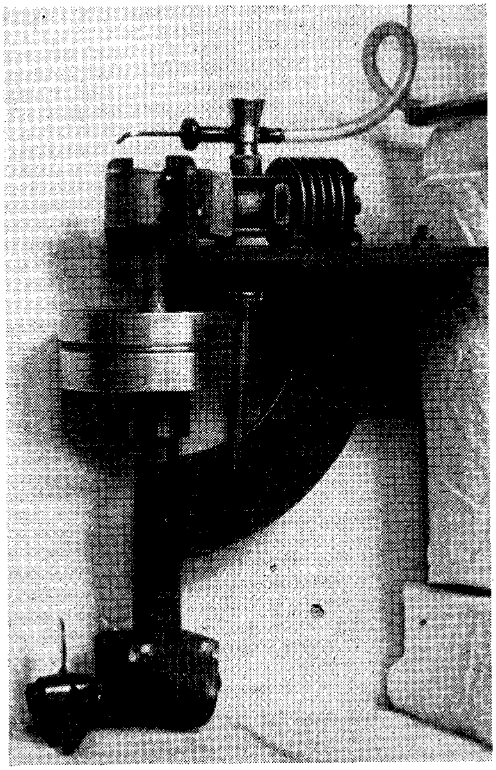
Q.—I have a double wound transformer by Heayberd & Co. with input of 210 volts and output of 12 volts, 12.5 amps. I should like to connect a selenium metal rectifier of 12 volts, 10 amps. Can you tell me the drop in volts (if any) I can expect? There are two tappings on the transformer which are fixed to a terminal on the steel case and appear to come from the secondary winding. Can you tell me what it is and its use?

R.—You may expect an output voltage of 6-8. This will depend upon the characteristics of the rectifier. If there is any space on the transformer, you could overwind to increase the voltage to about 18, which would give you the full output possible. The terminal to which you refer is for the purpose of earthing the secondary of the transformer, and this is necessary where the secondary wires are likely to be handled. Sometimes a metal (copper) screen is inserted between the primary and secondary, and this screen is in turn earthed. In either case, protection is given should the primary break down to the secondary.

PRACTICAL LETTERS

Model Outboard Unit

DEAR SIR,—The photograph here reproduced shows an outboard motor unit I have recently constructed which, although definitely off-scale, has proved very reliable and is completely self-contained. The engine is a 5 c.c. diesel with large capacity perspex fuel tank. I took the flywheel of a large petrol engine, as its 3 in.



diameter made it easy to spin over and made the engine quick-starting. Having only limited time, I kept the design as simple as possible, but apart from seizing-up, which fault was cured by the addition of an extension oil-cup, it has given no trouble during non-stop service since it was made last December. Apart from the engine and propeller, it was commercially stoved after spraying, and is virtually rust-proof yet of pleasing colour. Having no details of full-size units, I could not keep to scale outline and made it purely fuctional, as it has certainly proved to be.

Yours faithfully,

Leeds. B. C. JOHNSON.

V-belts on Lathe Drives

DEAR SIR,—I have noticed again and again in the arrangement of self-contained lathe drives that a V-belt of too large a section is employed.

A very common size used is the " A " section, which is $\frac{1}{2}$ in. wide at the top. This belt is far too stiff to bend over the small pulleys used on the motors so that the arc of contact is reduced very much, leading to much slipping. Also, a belt of this size transmits—when properly mounted—far more power than is needed, or available. So why use it? It is ridiculous to try to bend an " A " belt round a pulley $1\frac{1}{2}$ in. in dia., as is sometimes done. The minimum recommended size is about 3 in. dia. Users do not seem to know that there is a smaller size V-belt (" M " section) which is approximately $\frac{3}{8}$ in. wide at the top. This will do all that is required in a small lathe. For example, this belt when running at 1,000 ft. per min. on a pulley $2\frac{1}{2}$ in. dia. will transmit $\frac{1}{2}$ h.p., which is ample for lathes up to $4\frac{1}{2}$ in. centre. A pulley $2\frac{1}{2}$ in. dia. at 1,440 r.p.m. is close to 1,000 ft. per min. The minimum recommended pulley for " M " belts is about $1\frac{3}{4}$ in. dia.

A case of " over belting " I know of is where a $4\frac{1}{2}$ in. centre American " South Bend " lathe is driven by a " B " section V-belt ($\frac{5}{8}$ in. wide at top) although the motor is only $\frac{1}{4}$ h.p.! This is the maker's arrangement, so presumably they are satisfied with it. Further details in B.S./1440, 1948, for those interested.

Yours faithfully,

Cape Town. A. E. F. SPENCE.

Model Power Boat Trials

DEAR SIR,—I read with interest Mr. L. T. Cassanet's article on the above subject. He surely has given quite a lot of model power boat men something to ponder over. There is a lot of significance in those words, " the man with the necessary money and contacts."

It stands to reason that an amateur has not much chance against a commercially-built engine, especially those imported types which are built specially for the job.

There is also the question of fuel; methanol may be bought at model shops, but what about nitro-methane? Anyone who is able to obtain this fuel has an advantage over the chap who runs on Pool petrol.

I think it would be a good idea to run model power boat events on ordinary fuels which everyone can buy, i.e. Pool petrol for the i.c. enthusiasts. Of course, the compression-ignition engines would still want their particular fuel, which can be easily obtained.

Perhaps Mr. Cassanet would like to incorporate in his suggestions races of 1,000 yd. and over for speed boats.

The more we read about these commercial engines, the more the rank and file of amateur constructors are inclined to wonder whether it is worth while to carry on against such odds.

There are, however, a few stalwart exponents of the home-built engine who can still make a show, such as Mr. Cockman and his *Ifit*, and these deserve the utmost credit for their efforts to keep interest alive.

Yours faithfully,

Hexham. S. L. HORNSBY.